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COOPERATIVE ELK-LOGGING STUDY

Progress Report for the Period

January 1-December 31, 1973

COOPERATING AGENCIES

Region I, U. S. Forest Service
Intermountain Forest and
Range Experiment Station
Montana Fish and Game Department
Bureau of Land Management
School of Forestry, University of Montana

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August, 1974

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ABSTRACTS

COOPERATIVE ELK-LOGGING STUDY

January - December 1973

JOB I

PROBLEM ANALYSIS AND COORDINATION

During the year 20 meetings involving one or more members of the research committee were necessary to coordinate and plan project activities. A total of 9 presentations were made by research committee members to advance public awareness and understanding of the elk-logging study. In addition, project personnel made a significant contribution at the 1973 Western States Elk Workshop. A number of publications were completed during the period, bringing the project total to 22. Other activities during the period are reported.

JOB II-A

BURDETTE CREEK-DEER CREEK STUDY

Procedure A.1. Vegetation Analysis

Revised models for the distribution of habitat types are presented. The study area is apparently so large that a single model does not adequately describe all habitat types.

Procedure B.1. Pellet Count Survey

Distribution of elk, as indicated by pellet groups continued to decline in Deer Creek during 1973. Changes in elk use of other drainages, however, were apparently controlled by winter weather rather than the disturbance associated with the timber sale. The winter of 1972-73 was an extremely mild winter and distribution of pellets throughout the area indicated a shift to higher altitudes and to aspects which would normally be unused during the winter period.

Initial analyses of environmental preference pattern confirms the importance of midslope habitat, winter concentrations on southerly aspects and demonstrate annual variations associated with weather and the Deer Creek timber sale. Water did not appear to be particularly definitive in determining site selection by elk although there is some suggestion that areas over 1/2 mile from water are less desirable.

With respect to roads, there was a fairly strong avoidance of sites within 1/4 mile. However, elk use of areas beyond that distance was only slightly influenced and other factors, particularly weather, may be controlling.

Analyses of elk use of different kinds of cover produced some unexpected results. It is shown that low density tree cover is preferred during the winter--specifically in Ponderosa pine and Douglas-fir types. Summer use, however, is much more evenly distributed and a positive preference value for dense lodgepole pine is indicated. Shrub density was much less definitive for elk and the major finding is a suggestion that dense shrub stands of palatable species are preferred. Future analysis will attempt definition of tree and shrub combinations as well as separation of topographic influences.

Procedures B-2, B-3a, and B-3b. Elk Harvest, Distribution and Food Habits.

The 1973 elk hunting regulations in the study area vicinity were similar to the 1972 regulations, except that there was no early bull season. Increased hunter numbers and more favorable hunting weather (snow) were factors contributing to a checked harvest of 128 elk in the areas covered by the checking stations. This was a higher kill than in 1971 and 1972, and about the same as in 1963 and 1970.

Elk harvest inside the study area declined more than outside during the period 1970 to 1972, and increased less in 1973. Checked harvest in the Deer Creek-drainage, logged during the study period, declined from 4 in 1970 to none in 1972, and increased to 2 in 1973.

The sex-age composition of the elk harvest in 1973 was 33 yearling bulls per 100 older bulls, 138 bulls per 100 cows, and 34 calves per 100 cows. These ratios are near the average for the prior four years for which there are data. The proportion of calves was about the same as in 1972 and higher than in 1970 and 1971. Yearly age classification data showed the majority of harvested elk to be in the prime age class ($3\frac{1}{2}$ to $7\frac{1}{2}$ years). An increase in the old-aged class ($8\frac{1}{2}$ plus) was noted in 1973.

Herd composition counts of live elk in a sample of 91 elk on the winter range in March showed 25 bulls and 38 calves per 100 cows. These ratios are similar to those of previous years. Winter population trends appeared to be static. The aerial count of 150 elk in December, 1973, was about the same as the April, 1971, count.

Radio tracking of instrumented elk indicated some animals stay in the study area while a major portion of them summer in the upper parts of the Cache Creek, Montana Creek, Cedar Log Creek, and Indian Creek drainages. Bulls tend to move even farther and are more vulnerable to hunters. Three marked bulls were all killed by hunters (2 in Idaho), while none of nine cows was killed.

Radio tracking, combined with ground observation, yielded considerable data on use of different habitat types by elk. One of the radioed cows summered in a roaded area and apparently used clear cuts for feeding.

JOB II-B

LONG TOM CREEK STUDY

Procedure A.1. Vegetation Analysis

Data for 560 points classified on aerial photographs and 46 areas sampled on the ground are presented. Aerial photo classifications for this area proved to be relatively inaccurate because small trees in the understory were classified as shrubs. Two models are presented: one estimates tree basal area and vegetal cover, the other describes habitat types for the study area.

Procedures B and C. Elk Use and distribution

Evaluation of elk use of the Long Tom Creek study area was done on a seasonal basis from June through August (summer season), September through early October (rutting season), and early October through late October-early November (first third of hunting season) for both the 1972 and 1973 field season. Elk use of the study area appeared to be greater in August 1973 than in August 1972 while elk use from September-early October and in early November during 1972 appeared to be greater than for similar time periods in 1973. These differences were statistically significant ($P=.05$). During summer for both years, the broken park and timber general cover types were the most and least preferred by elk, respectively.

During the rutting season the timber type was indicated to be preferred during both years, while in 1973 elk use of the park and broken park types appeared to be nearly proportionate to their occurrence. In 1972 elk use seemed to be higher in the park and lower in the broken park type. Elk use of the clearcut general cover type for both of these seasons was about proportionate during both years. During the early portion of the hunting season elk use was nearly proportionate for all cover types for both years.

A major influencing factor on elk use and distribution during the summer appeared to be wetness condition. A positive correlation of elk use with average wetness degree occurred during the second, third and fourth "runs" of the route system in 1973. This correlation was statistically significant ($P=.05$) for the second and third runs. Over one-fourth (27 percent) of the total elk use during this season in 1973 occurred in that portion of the foot route system classified as "wet broken park", which comprised only one-tenth of the route system. The most intense elk use occurred in those segments with a wetness type of standing water-marsh with a wetness degree of from 50-90 percent and in those segments with a wetness type of standing water-marsh-bog with wetness degrees of 26-50 percent and 91-100 percent. Wetness type and degree seemed to decrease in importance during the rutting season for both 1972 and 1973.

Measurements of 124 elk bedding sites during the summer and early fall of 1972 and 1973 also indicated a strong affinity for wetness accompanied with small broken parks with light downfall and Engelmann Spruce *(Picea engelmanni)* the dominant tree species, with numerous trees less than 10 feet tall.

Elk use measured in August of 1973 was distributed similarly to the elk use measured in August 1972 with exception of 5 of the 16 subdivided areas. The mean elk use didn't change within the study area between the second, third, and fourth runs in 1973, but shifts of elk use did occur between runs and subdivided areas. Elk use measured in Sept.-early Oct. 1973 was distributed similarly to the elk use in 9 of the 16 subdivided areas measured during this same time period in 1972. Although the level of elk use during Oct.-early Nov. for 1972 was higher than for this same time period in 1973, there was a tendency for the elk to be similarly distributed during both of these years.

Cattle use and distribution within the study area appeared to be a major influence on elk use and distribution. The data indicated elk not only avoided segments freshly used by cattle, but also avoided segments with current year's previous cattle use. Elk seemed to prefer those segments with 0-25 percent forage use and notably avoided those segments with forage use over 75 percent. By the end of September in 1972 and 1973, the average forage use of the route system was 62 and 30 percent, respectively.

JOB II-C

SAPPHIRE ELK STUDY

Three years of intensive field work have been completed on a study of elk in relation to logging in the Sapphire Mountains south of Missoula. Elk wintering on the Threemile Game Range were marked with radio collars and were tracked 2-3 times each week from May to December. Movement patterns, activity and habitat use information has been attained from the radio-tagged animals. The winter ecology work has been described by Beall (1974).

In 1971, when the Sapphire Sale was being actively logged, elk appeared to avoid the sale area. The sale area was used more during 1972 and 1973 although few observations were made of elk on clearcuts. Data on summer-fall habitat use is currently being analyzed. Elk movements will continue to be monitored for 3 more years, as two new sales will be logged starting this summer.

JOB II-D

Chamberlain Creek Study

This report covers the 3rd year of study in Chamberlain Creek. Pre-disturbance data collection concerning elk use of their food and cover and timber condition, production, and composition was completed for the original area of study. The raw data on habitat relationships are not yet analyzed. Timber production and composition data have been analyzed and a timber management inventory, analysis, and plan has been prepared. This inventory and plan is summarized in the body of this report. All timber resource data collection and plan preparation, described as Procedure A under the Chamberlain Creek Study plan, is now considered complete. Procedure A will be discontinued in future study.

All general elk data concerning use of food and cover in the undisturbed drainage have been completed for the initial area of the study. An area of 1,300 acres has been added to the study under a new agreement with Burlington-Northern Inc. Procedure B.1.a. will be continued to collect base data on this additional area.

Supplemental pellet deposition measurements were made along the Chamberlain Mountain Jeep Road. Mapping of vegetative cover, i.e., horizontal visibility in relation to elk use, indicated that this trail is influencing elk behavior. Whether or not this trail influence is affecting gross distribution of elk in Chamberlain Creek is unknown.

Data collection for a vegetative analysis of the study area was completed last reporting period. This procedure must now be continued to collect information on 1,300 additional acres under the Cooperative Agreement with Burlington-Northern Inc.

JOB III-A.1

Ruby Road Closure Study

The 1973 hunting season was the fourth and final data collection period of the study. The number of hunters checked per operating day (211) of the check station in 1973 was 11 percent fewer than was checked in 1971 and 1972, respectively. Forty-five percent of the total number of hunters checked during the entire study were checked the first week of the season (opening day through the following weekend). The average number of hunters per hunting party averaged 2.9 for all four years.

The data indicated the road closure restrictions imposed on the upper unit of the study area in 1972 and 1973 may have been the major factor causing a decline in hunter use of that area during these years. Hunting pressure within the study area, especially the upper unit, was more uniform throughout the 1972 and 1973 (closure) seasons compared to the 1970 and 1971 (pre-closure) seasons. At least 90 percent of all the hunters interviewed during the closure years approved of the closure.

During the 4 years of the study an average of 71 percent of all elk checked at the check station was recorded within the first week of the season. Both elk harvest and hunter trip success increased during the 1972 and 1973 hunting seasons in the upper unit compared to 1971 and 1970.

The closure restrictions appeared to increase the capability of this unit to "hold" elk for a longer period of time and/or the foot and horse hunting methods necessary for hunting elk gave the individual hunter in that area a better chance to bag an animal. Radio marked elk in 1972 and 1973 also indicated a general tendency to stay in the upper unit of the study area longer than previously. The closure restrictions appeared to increase hunter effort (hours walked per hunter per day) during the entire hunting season in both the upper and lower (unrestricted travel) units of the study area. Elk observed per unit of hunter effort (elk seen per hunter hour walked and elk observed per hunter per day) showed a significant increase during the second half of the season in the upper unit during the two closure years. Two percent of the study area hunters checked in 1973 were road hunters (they did no walking) and accounted for less than 1 percent of the elk observations.

JOB III-A.2.

Judith Road Closure Study

Hunter interviews at weekend checking stations provided data on distribution of elk and of hunters, and on elk harvest, during four hunting seasons. Access on the 225 sq. mi. study area was unrestricted in 1970 and 1971. During the 1972 and 1973 seasons, access was limited on approximately 50 percent of the area by permanent closure of 70 miles of a 167-mile network of roads, and by prohibition of all off-road vehicular travel. Restricting access had no apparent effect, either beneficial or detrimental, on hunting pressure or on distribution of hunters or of elk. However, in the years of limited access, hunters reported seeing almost 50 percent more elk than did the hunters in the two prior years of unrestricted access. Evidence is also strong that elk harvest had increased after road closure, but between-year variability in kill data renders this uncertain.

The increase in elk sightings presumably resulted from fewer road hunters under limited access. Only 1 in about 12 hunters was a road hunter following road closure, compared with 1 in 6 in the two years before road closure. Road hunters simply see less elk than do field hunters. Field hunters made from 95 percent to over 99 percent of all elk sightings and harvested all but one of the reported kills in the four years of study. Elk did not leave the area as a result of hunting pressure, but they did move about considerably within the area. Elk distribution seemed unrelated to hunter distribution.

JOB III-B

ELK USE OF DISTURBED AREAS

A total of 49 clearcuts have been sampled to determine the distribution of elk pellets in the opening and surrounding uncut forest. Analyses are confounded by differences among game population levels in the various areas sampled. Further analysis is in progress, but tentative conclusions are:

1. Elk avoid roads even where there is no traffic
2. Uncut forest above an opening is preferred to uncut forest below an opening
3. Cover quality of the uncut forest around an opening is important to elk
4. Good slash cleanup favors elk use of clearcut openings
5. Smaller openings are favored (unfortunately, the analysis, to date does not provide a definition of "small").

Elk Management Recommendations for the Consideration of Land Managers

INTRODUCTION

The cooperative elk-logging study has concluded its 4th year and a large quantity of data have been gathered. Certain findings appear to be firmly based and worthy of consideration. In order that management can benefit from the study effort prior to the final report, the research committee has been directed by the steering committee to formulate tentative management recommendations or guidelines based on findings-to-date.

It is not intended that these recommendations be broadly applied throughout the forests of Montana. Likewise, it is not intended that they be considered the "last word" or an attempt to dictate management practices to public agencies or private corporations. It is intended that they be considered a portion of the wildlife input that should be evaluated, along with many other values and inputs, in the planning of all timber sales and road construction projects. If a recommendation fits the situation, in an identified elk-use area, its implementation will help minimize any detrimental impact on the elk in the area. The recommendations merely represent an attempt by the study team to place significant findings in the hands of management as the research study progresses.

The following recommendations, although based on the best information presently available, are considered tentative and subject to change; the hazards of extrapolation must be recognized. They may not apply to certain local situations and literal application should not be substituted for detailed, joint discussions and on-the-ground inspections by timber and wildlife managers and other resource specialists.

RECOMMENDATIONS

1. Research Finding:

   During active road building and logging, elk have responded by moving to surrounding ridge lines and further. The distance moved apparently depends on a variety of factors including size of drainage, area encompassed by logging, intensity of logging activities, and disturbance on the ridge lines.

   Elk displacement, which is considered temporary, has been detected as far away as 4 miles. In one instance, displacement was to an adjacent, undisturbed third order drainage. In another investigation, displacement was down a ridge-line for two miles through undisturbed timber and over a point. In both cases, topographic features provided a line-of-sight barrier between the elk and the logging activity.

Recommendation: Planning for timber sales in elk summer range should include provision of a security area immediately adjacent to the disturbed area during the active logging and/or road building period. This security area should provide a line-of-sight barrier and be inaccessible to motorized traffic. In some instances, this may be accomplished with an area closure.

The actual size of the security area should be determined by on-the-ground consultation between wildlife and timber managers. To realize the full value of this recommendation, the ridge line between timber sale activities and the security area should remain intact with roads and logging activity below the skyline.

2. Research Finding:

When crossing roads, elk have indicated a preference for road sections through dense timber where visibility is relatively low and security relatively high.

Recommendation: During the location and design of transportation systems, existing elk movement patterns and probable elk crossing areas should be identified and provisions made to provide security for unimpeded movement. Where possible, several alternate routes should be considered. Primary consideration should be given to:

a) maintaining frequent dense cover areas adjacent to the road;

b) minimizing cuts, fills, and right-of-way clearings;

c) avoiding long stretches of straight road; and

d) providing adequate slash disposal along rights-of-way.

3. Research Finding:

Within the various study areas, findings-to-date indicate elk prefer those sites at the head of drainages bordering streams or marshy meadows, or occupying moist swales or benches. East of the Continental Divide, the dominant vegetative components of these sites are Subalpine fir, Whitebark pine, spruce, or combinations thereof. These sites are usually found within the *Abies/ lasiocarpa/Calamagrostis canadensis* and/or the *Abies lasiocarpa (pinus albicaulis)/Vaccinium scoparium* habitat types as described by Pfister, et al. (1973). In Western Montana these moist sites are generally found within the *Abies lasiocarpa/Luzula glabrata (menziesia* phase), *Abies lasiocarpa/ Clintonia uniflora* and *Abies lasiocarpa/Menziesia ferruginea* habitat types as described by Pfister, et al. (1972).

Recommendation: Moist sites (wet sedge meadows, bogs, seeps, etc.) have been identified as a very important component of elk summer

Range especially when these sites occur in the *Abies lasiocarpa/Calamagrostis canadensis* and/or the *Abies lasiocarpa (pinus albicaulis)/Vaccinium scoparium* habitat types in Eastern and Central Montana, and the *Abies lasiocarpa/Luzula glabrata (menziesia* phase), *Abies lasiocarpa/Clintonia uniflora* and *Abies lasiocarpa/Menziesia ferruginea* types in Western Montana.

Preferred summer elk range exists when these moist sites are interspersed with other necessary habitat components including various timber types and densities, dry, broken and open parks, and various other physical characteristics.

Where these situations exist, an area large enough to maintain the overall integrity of the habitat components should be managed by protecting them from alteration. The size of the area to be managed should be determined by an on-the-ground inspection by land and wildlife managers and other appropriate resource specialists.

4. Research Finding:

Location and density of roads, and the use made of those roads, may be disturbing to elk, depending on intensity, type, and season of use, as well as other factors.

Recommendation: Wildlife managers should identify local area elk requirements to be used as a basic consideration in every road system plan or road management decision. Proposed road systems should be evaluated for impacts on elk on a case by case basis. Existing roads should be evaluated to see if abondonment or closures would enhance elk management. ORV closures should also be considered, and Federal land managers should assess the suitability of the new Federal ORV regulation in this connection. State regulations may also apply to ORV use.

5. Research Findings:

Two phases of the project involved area closures which restricted motor vehicle travel to a few selected roads.

Results of the Judith Road Closure Study indicate little or no change in elk distribution or harvest resulting from imposed travel restrictions. Apparently, area closure measures were not necessary to "protect" elk under the existing pattern of cover and terrain. However, hunters reported seeing more elk under the restrictions than during unlimited seasons and seemed to prefer the limited access because of the "higher quality" hunt it afforded.

Results of the Ruby Road Closure Study indicate the area closure had a significant effect on elk distribution, harvest and hunter use of the area. This area was characterized by a relatively open, broken forest with gentle terrain and easy access. Elk stayed in the restricted area longer and in greater numbers than during

preclosure years, resulting in more uniform season-long hunting pressure and elk harvest. Although hunter participation decreased, hunter success increased and more elk were observed per hour of walking. Most hunters interviewed felt the quality of their hunt had been increased because of the area closure.

Recommendation: Before a vehicular closure is considered, the elk management goal or objective should be scrutinized and clearly defined, being especially cognizant of the following situations or potential problem areas:

It appears that closures will generally:

1. Change the relative quality of elk hunting in the closed area;

2. Reduce harassment of game animals; and

3. Present some problems because of increased difficulty for hunters retrieving bagged animals.

Road closures may be good or bad depending on the elk management goal or objective for a specific hunting unit or area. Depending on terrain, existing access and patterns of cover, effects of area closures on elk management could apparently vary:

1. From no change in hunter participation to a significant change;

2. From no change in elk distribution to a significant change, with elk staying in an area longer and in greater numbers; and

3. From no change in elk harvest to an increase or decrease, with a more uniform season-long harvest; hunters will usually see more elk per unit of walking effort.

LITERATURE CITED

Pfister, Robert D., et al. 1972. Preliminary forest habitat types of Western Montana, May 1972. U. S. Forest Service, Intermountain Forest and Range Experiment Station and Region I. 80 pp.

_____, et al. 1973. Preliminary forest habitat types of central and eastern Montana, May 1973. U. S. Forest Service, Intermountain Forest and Range Experiment Station and Region I. 88 pp.

JOB I

Problem Identification and Coordination
Progress Report for the Period
January 1, 1973 - December 31, 1973

INTRODUCTION

The objectives of this job are to identify the basic conflicts between timber harvest and elk ecology in the various forest types of Montana and to plan and coordinate research efforts. While these are basically unproductive activities from the viewpoint of findings, they are necessary for the smooth operation of the project and to insure that all objectives are fulfilled.

Committees

The project steering committee for 1973 included the following members:

Region I, USFS	Roger Bumstead, Chairman
Montana Fish & Game Dept.	Wynn Freeman
Bureau of Land Management	Carl Lind
Intermountain Forest and Range Experiment Station	Ralph Klawitter
School of Forestry, University of Montana	Robert Wambach

The project research committee for 1973 included the following members:

Montana Fish & Game Dept.	Eugene Allen, Chairman
	Reuel Janson
	Terry Lonner
Intermountain Forest and Range Experiment Station	Joe Basile
	L. Jack Lyon
Bureau of Land Management	Richard Ellison
	Robert Bennett
Region I, USFS	Floyd Pond
School of Forestry, University of Montana	Robert Ream

ACTIVITIES

During the year, 20 meetings were necessary for project planning and coordination. The research chairman attended all but 10 of the following meetings; meetings marked with an asterisk (*) indicate meetings where two or more members of the research committee were present. Eighteen, 21 and 28 coordination meetings were necessary in 1972, 1971 and 1970, respectively.

Date	Location	Meeting
Jan. 11, 1973	Hamilton	Interagency Meeting discussing proposed elk study
Jan. 30	Missoula	Research chairman met with steering committee
Jan. 30	Ninemile District	Ninemile Ranger District
Jan. 31*	Missoula	Research Committee Meeting
Feb. 20-21*	Bozeman	Western States Elk Workshop
Mar. 13-14*	Missoula	Joint steering-research committee meeting
Mar. 16-20	Washington, D.C.	North American Wildlife & Natural Resources Conference
Apr. 2	Challis, ID	Challis-Salmon Interagency meeting
May 1	Ninemile District	Ninemile Ranger District
May 16*	Missoula	Discuss Long Tom Creek data analysis
May 25	Missoula	Meeting of research and steering committee chairmen
July 24, 25*	Judith, Chamberlain Cr.	Joint research-steering committees summer field trip
July 26	Missoula	Tour Burdette study area for Washington, D.C., U.S.F.S. personnel
Aug. 9	Missoula	Program summary for Norman Borlaug at Forestry Sciences Lab
Oct. 4	Missoula	Met with Jim Betty of B-N to review Sapphire study
Oct. 25*	Bozeman	Discussed Ruby check station problems with D-3 personnel
Oct. 30*	Missoula	Met with Jim Betty of B-N to review Sapphire study
Oct. 31	Bozeman	Review Long Tom and Ruby studies with Jim Betty of B-N
Dec. 18, 19*	Bozeman	Research committee meeting
Dec. 20	Missoula	Review Burdette study with Jim Betty of B-N

During the year, 9 talks or programs concerning the elk-logging study were presented to various groups. This compares to 5, 23 and 5 for 1972, 1971 and 1970, respectively. The Western States Elk Workshop was held in Bozeman Feb. 20-22, 1973. Most members of the research committee participated in this conference and gave a total of 9 presentations, representing a significant portion of the second day's program. A listing of the year's programs follows:

Date	Organization	Speaker
Feb. 20-21, 1973	Elk Workshop, Bozeman (9 presentations)	Allen, Basile, Lyon, Ream, Beall[1] and Marcum[1]
Feb. 27	Southwest Montana Natural Resource Council, Butte	Allen
Mar. 7	Naval Reserve Unit, Missoula	Ream
Apr. 23	Corps. of Engineers Class, Missoula	Ream
May 5	Montana Wildlife Federation, Kalispell	Ream
Sept. 19	Butte TV-KXLF, "The Forest Service Today" program	Lonner
Oct. 17	Butte TV-KXLF, "The Forest Service Today" program	Lyon
Nov. 5	Butte Cable TV	Lonner
Nov. 19	Sentinel H.S. Environmental Club, Missoula	Ream
Dec. 3	Butte Cable TV	Lonner

[1]Graduate students working on the Sapphire phase of the project.

During the 1973 report period, research committee members were responsible for several publications. In addition, two M.S. theses were completed from jobs associated with the Sapphire phase of the project; abstracts are printed in the appendix of this annual report. Through December 1973, the elk-logging project has been responsible for a total of 22 publications; a chronological listing follows:

CHRONOLOGICAL LISTING OF
ELK-LOGGING PROJECT PUBLICATIONS[1]
June 1970 - Dec. 1973

Lyon, L. J. and Research Committee. June 1970. Prospectus for an interagency evaluation of the effects of logging on Montana elk populations. 16pp.

_____ and _____. October, 1970. Outline, Cooperative Research Program: Effects of Logging on Elk. 10pp.

_____ and _____. November 1970. Mid-year Progress Report -- Cooperative Research Program: Effects of Logging on Elk. 6pp.

Bohne, J. December, 1970. Elk food habits, distribution and habitat utilization in the Burdette and Deer Creek drainages, Lolo National Forest. Progress Report. 5pp.

Lyon, L. J. January, 1971. Some observations on the Chesnimnus report. 16pp.

Research Committee. February, 1971. Cooperative elk-logging study plan. 21pp.

Allen, E.O. March, 1971. Elk-logging relationships in the northern Rocky Mountains. Presented at the Northwest Section, Wildlife Society Annual meeting, March 25-26, 1971, Bozeman, Montana. 7pp.

_____. April, 1971. Elk-logging relationships in the northern Rocky Mountains. Presented to Annual Meeting of Northern Continental Conservation Committee, April 18, 1971, East Glacier, Montana. 6pp.

Research Committee. June, 1971. Cooperative elk-logging study progress report, April-December 31, 1970. 71pp.

Lyon, L. J. July, 1971. A cooperative research program -- effects of logging on elk in Montana. Presented at joint Annual Meeting of the Western and Midwestern Associations of Fish and Game Commissioners, Snowmass-at-Aspen, Colorado, July 19-23, 1971. 9pp.

Research Committee. August, 1971. Brochure: Elk-Logging: A Closer Look at a Problem in Resource Management.

Bohne, J. October, 1971. Elk food habits. Progress report. 10pp.

Allen, E. O. December, 1971. Effects of logging on elk populations. Montana Fish and Game Department Progress Report. Proj. W-120-R-2, Jobs BG-3.04 - 3.10. 27pp.

_____. January 1972. Elk and Timber, a public land jigsaw. Montana Outdoors, January - February, 1972. 3pp.

Research Committee. February, 1972. Cooperative Elk-Logging study plan, Fiscal year 1972-73. 17pp.

_____. August, 1972. Second annual cooperative elk-logging study progress report, January 1 - December 31, 1971. 129pp.

Allen, E. O. January, 1973. Effects of logging on elk populations. Montana Fish and Game Department Progress Report. Proj. W-120-R-3, Jobs BG-3.04 - 3.12. 26pp.

Research Committee. February, 1973. Cooperative elk-logging study plan. 22pp.

Stankey, G., R. C. Lucas and R. R. Ream. March 1973. Relationships between hunting success and satisfaction. Proc. 38th N. A. Wildl. Conf. pp235-242.

Denton, J. 1973. A radio telemetry system for elk: its use and efficiency. M.S. thesis, University of Montana, Missoula. 77pp.

Stehn, Thomas V. 1973. Daily movements and activities of cow elk in the Sapphire Mountains of Western Montana during summer and fall. M.S. thesis, Univ. of Montana, Missoula. 66pp.

Research Committee. July 1973. Third annual cooperative elk-logging study progress report, January 1 - December 31, 1972. 173pp.

[1]Publication is defined as anything printed and circulated.

An annual, summer, joint research-steering committee field trip is conducted each year to acquaint committee members with the various study areas. July 24 and 25, 19 and 14 persons, respectively, viewed the Judith and Chamberlain Creek study areas. All project study areas have now been viewed by the joint committee.

At the winter meeting it was decided that pertinent findings be made available to managers as soon as possible and the research committee was directed to draft a set of management recommendations based on findings-to-date. After seven drafts, some recommendations were finalized and approved; they are included in this annual report.

Considerable other time was spent preparing the next year's study plan and budget, preparing news releases, reviewing literature for a bibliography on elk-logging relationships, reviewing pertinent studies in other states, updating the report mailing list and answering correspondence received asking about various aspects of the elk-logging study.

Submitted by: Eugene O. Allen.

JOB II-A

PROCEDURE A.1.

BURDETTE CREEK-DEER CREEK VEGETATION ANALYSIS

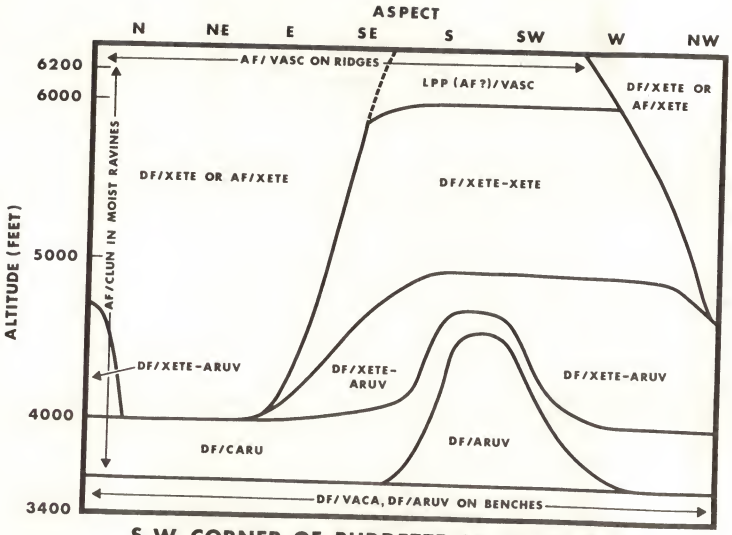
REPORT FOR THE PERIOD

Jan. 1 - Dec. 31, 1973

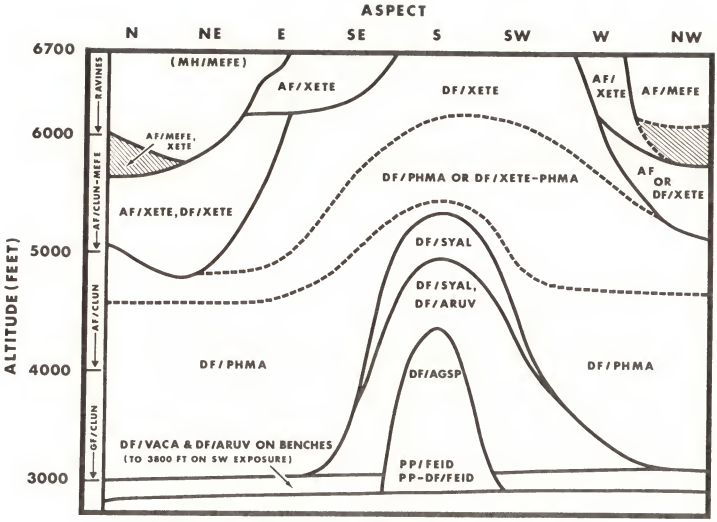
Vegetation analysis for this study area was completed and reported in the 1973 progress report. However, some problems were encountered in the use of the habitat-type model. As a result, Dr. Stephen Arno of project FS-INT-1205 reexamined the area and determined that there is a clear separation of two different habitat-type groupings within the study area.

The primary separation shown in Figures 1 and 2 is associated with the absence of the DF/PHMA habitat type in the southwest sector of the study area and the apparent expansion of DF/XETE phases into aspects and attitudes previously listed as DF/PHMA. The two figures also supply a much more definitive expression of bench and ravine habitat types.

Submitted By: L. Jack Lyon



S.W. CORNER OF BURDETTE CR. STUDY AREA



DEER CR. - BURDETTE CR. ELK STUDY AREA
(ALL BUT SW CORNER)

JOB II - A

Procedure B - 1

CONDUCT ANNUAL PELLET COUNT SURVEYS TO DESCRIBE ELK DISTRIBUTION PATTERNS WITHIN THE BURDETTE CREEK--DEER CREEK AREA

Progress Report for the Period January 1 - December 31, 1973.

INTRODUCTION

Pellet distribution surveys in Burdette Creek, Deer Creek, and adjacent drainages were initiated in the fall of 1970. The two major objectives of these surveys were (1) to describe elk distribution patterns before, during and after the timber sale in Deer Creek, and (2) to describe elk use of the available environment with particular attention to factors which indicate preferences or specific avoidance patterns.

During 1973, special emphasis has been placed on the geographical distribution analysis responding to objective (1) and on at least partially presenting the environmental preference data in response to objective (2). Reporting deadlines again prevented the completion of all data available for the 4 years of study.

METHODS

A complete description of the methods used to collect pellet-count data was presented in the 1973 progress report. The only significant changes for the 1973 count were (1) the addition of an area on Garden Point between the South Fork of Petty Creek and Johns Creek to the study area, and (2) a new approach to cover classifications along the transect lines. This technique and the resulting data will be described in the report section on Environmental Preferences.

During 1973, as a result of the additional survey area on Garden Point, a total of 383.9 miles of pellet-group transect was surveyed. This compares with 277.2, 320.5, and 324.7 miles during 1970, 1971, and 1972.

ANALYSES

The decline in the study area elk population apparently continued during 1973, but the change from 1972 to 1973 was relatively minor. As shown in Table 1, the average number of pellet groups per mile of transect dropped less than one group or about 2 1/2 percent.

Table 1.--Numbers of Elk Pellets Counted by Years and Relative Size of Population, Burdette Creek--Deer Creek Study Area 1970-1973.

Year	Total Pellet Groups Counted	Total Miles Transect	Pellet Groups Per Mile
1970	10,830	277.2	39.1
1971	9,651	320.5	30.1
1972	7,856	324.7	24.2
1973	9,048	383.9	23.6

However, the shift of pellet groups into the very old category (Table 2) suggests that the decline in population may have been in the general range of 5-8 percent.

Table 2.--Pellet Groups Per Mile by Age Class, 1970-1973.

Age Class	Year			
	1970	1971	1972	1973
Fresh	1	1	0	0
New	9	5	3	3
Old	19	14	10	9
Very Old	10	11	11	12
TOTAL	34	30	24	24

Elk Distribution

Several summaries of elk pellet distributions were presented in the 1973 progress report. In the interest of brevity, only the summary by drainage subunit is present here (Table 3 and Figure 1).

Activity on the study area during 1972-1973 included a continuation of the timber sale in Deer Creek plus some continuation of the logging in Howard Creek (south of the South Fork of Petty Creek) and preparations for a timber sale in the Garden Point area. The winter of 1972-73 was exceptionally mild and the summer of 1973 was dry enough that a fire-season closure was imposed in late August and early September. The combined effects of weather and logging activity on elk distribution were demonstrated in several changes from 1972.

Table 3.--Elk Distribution Trends, Pellet Groups Per Mile as Percentage of the Mean for the Total Study Area, 1970-1973.

Subunit	All Pellets				Summer				Winter			
	70	71	72	73	70	71	72	73	70	71	72	73
Wall Canyon To Lion Creek	78	95	105	68	76	106	100	73	81	101	110	69
Deer Creek Above Wall Jct.	68	56	45	34	84	72	56	45	55	48	46	32
Eds Creek & Gus Creek	100	80	78	112	113	103	100	142	86	68	68	100
Wig, Owl, & Upper Hyde	90	108	82	66	96	114	101	60	88	121	83	72
Burdette Creek Above 5000	70	92	61	101	87	108	60	118	63	79	54	92
Burdette Creek Below 5000	168	173	210	195	134	116	167	138	195	190	224	211
Johns Creek & S.Fork Petty	95	76	87	100	98	80	96	128	91	70	81	86
Lower Hyde, Burdette, Lupine	79	73	80	55	65	67	104	40	84	70	82	57
Upper Lupine Creek	114	125	141	147	109	114	151	110	118	127	140	158
Pellet Groups Per Mile	39	30	24	24	29	20	13	12	29	25	21	21

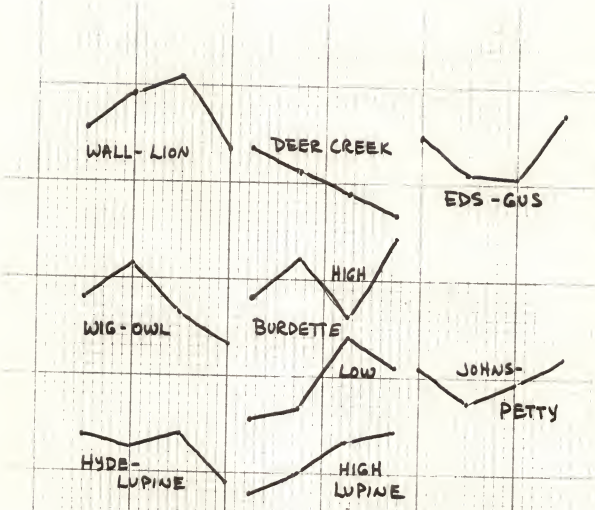


FIGURE 1.- FOUR-YEAR TREND OF ELK-PELLET DENSITIES, NINE SUBUNITS OF THE BURDETTE CREEK - DEER CREEK STUDY AREA; 1970, 1971, 1972, 1973.

Elk use of Deer Creek continued to decline at about the same rate recorded since the study was initiated. In 1973, it reached 50 percent of the pre-logging level and about one-third the average level for the whole study area. Elk use of the Wig Creek, Owl Creek and Upper Hyde Creek unit also continued to decline, but it seems probable that disturbances associated with the elk trap in Wig Creek may have contributed as much the timber sale to this decline.

Overall, the single most important factor contributing to the 1972-73 shift in elk population distribution was probably weather rather than logging. The extremely mild winter allowed elk to spend more time above 5000 feet than is usual for the Burdette Creek area. The shift to higher altitudes and to more mesic aspects is pronounced in every drainage except Deer Creek. Use of the west half of the area, mostly west aspect, declined in all drainages while use of the east half of the area increased in all drainages. Traditional winter range below 5000 feet in Burdette Creek received less use while use of the area above 5000 feet increased.

Elk Environmental Preferences

In addition to the pellet group information, a series of independent environmental variables have been described for each of the transect segments within forties on the Burdette Creek-Deer Creek area. With the exception of cover, these variables have been described in previous reports and are only listed here:

Cover	Location
Elevation	Distance to Water
Aspect	Distance to a Road
Slope	Distance to non-road Disturbance
Topography	

Cover: During the 1973 pellet counts, observers were requested to record the vegetation along each segment of the transect line in accordance with the scheme demonstrated in Figure 2. The main consideration in this classification was to produce an extremely simple morphological record of vegetation structure. Species composition, up to two tree species and two shrub species, was also recorded, but the initial analyses are designed to treat species composition in extremely broad terms.

Figure 2 is a copy of the field explanation sheet for cover classification.

Figure 2.--Cover Classification Scheme for Burdette Creek-Deer Creek Pellet Transects.

COVER CLASSIFICATIONS

For each segment of the pellet-count line, record an average description of the cover using the following code:

TREES: 3 - Canopy cover over 75 percent
2 - Canopy between 25-75 percent
1 - Canopy under 25 percent
0 - No trees (or none with dbh over 2")
Also record the most important species.

UNDERSTORY: 3 - Shrub canopy over 75 percent
2 - Shrub canopy 25-75 percent
1 - Shrub canopy under 25 percent
0 - No shrubs
Also record the most important species.

In those cases where shrub canopy is 0 or 1 write in the most important plant species in the understory (or write talus or slash if that's what it is).

If this works as it should, the cover codes should consist of 4 or 5 items as in the following examples:

3 dougfir	3 Vame
3 dougfir	1 Vame Xete
3 lodgepole	0 Xete
0 ------	2 Maple Willow
1 ponderosa	1 Snowberry grass
1 dougfir	0 Grass talus
2 larch	2 Vame slash

Item 1 is tree canopy number
Item 2 is tree species (usually only one, but put two species in if necessary).
Item 3 is shrub canopy number.
Item 4 is the most important shrub species or the ground cover if there are no shrubs.
Item 5 is optional--a second shrub species, ground cover, or blank--whatever seems to best characterize the situation.

Analysis: Although a potential for multiple regression is inherent in these data, some of the assumptions required for multiple regression cannot be satisifed. Most important is the fact that elk distribution on the study area is only locally determined by specific environmental variables. In an area this large, habitual behavior patterns, climate, and other factors probably determine where animals are located at any one time. Thus, environmental selection is limited to the choices available on a relatively small area.

Program ENVIRON performs the following sequence of operations on a matrix in which each cell contains the pellet groups per transect unit data recorded on the study area:

1. Calculates the mean for nine adjacent cells. This number becomes the estimate of elk use for a 360 acre area in which the animals present are assumed to have had an equal opportunity to select any one of the nine forties.

2. Calculates the difference between the mean for 360 acres and the data for the central forty acres. A positive difference is presumed to indicate elk preference while a negative difference indicates avoidance.

3. Summarizes these deviations in specified environmental variable categories. Categories with no consistent influence should tend toward zero, while variables with a consistant positive or negative influence should prove additive. As currently written, the program deletes all observations in which the calculated deviation is greater than 5.0. Deviations of this magnitude tend to occur where very short transect segments cross a trail or other heavy-use area. The resultant calculations are considered aberrant descriptions of actual elk distribution.

4. For each environmental variable tested, output is in the form of a table listing the number of observations and the mean deviation for each class of the variable. For example:

Variable	N	Mean
A	175	+ .03
B	525	- .02
C	350	- .15
Total	1050	- .01

In presentation, the overall mean is adjusted to zero and means of individual variables adjusted correspondingly. Thus, in the example above, variable A would have a value + .04 and variable B - .01. In an average set, the total number of observations ranges from 950 to 1500, the mean is between - .03 and + .02, the variance is about 0.73 and one standard error is 0.023. For purposes of statistical estimate, it is assumed that any difference between means or deviation from zero in excess of .05 is significant. All means in the following presentations have been multiplied by 100 and the decimal point deleted.

In addition to the analyses based on total numbers of elk pellet groups it was possible to separate summer from winter use by treating only those groups aged as fresh new and old (summer) separately from those aged old and very old (winter). The program also allows examination of two variables simultaneously, for example aspect and altitude. Thus, with nine variables examined independently and in pairs and three different groupings of pellets by age, it is possible to produce 135 combinations of output. Obviously, not all combinations are meaningful, and of the 60 that were actually produced less than a third will be presented in this report.

Aspect and Altitude

Of the variables examined, aspect and altitude seem logical for initial presentation because the distribution of pellet groups based on these variables provides a validation for other, less obvious relationships. In presenting the data in Tables 5-8, a weighted running mean has been used at each altitude to increase the sample size for any one aspect. For example, the observations on N, NE, and E aspects have been combined in the mean for NE. The summary in Table 4 simply presents average values recorded in the tables of annual data.

Table 4 establishes several important facts about the year around distribution of elk in the Burdette Creek-Deer Creed area. Midslope locations on southerly aspects receive the most elk use, particularly in the winter, when locations between 4500 and 5500 feet on SE to SW aspects are very heavily utilized.

The consistently negative values for 6500 feet demonstrate that elk do not nornally remain on the higher ridges for periods of time. However, it should also be recognized that these negative numbers also describe the fact that an elk reaching 6500 feet must have been at 6000 feet twice because there are no alternative choices at higher altitudes.

The negative values for 4000 feet during the winter are particularly interesting because they confirm that most areas of this description are below the winter range acceptable to elk. Such areas are generally near creek bottoms where snow would be expected to accumulate and disturbance from winter traffic might be a disturbing influence.

Table 4.--Means of Elk Site Selection, 1970-1974, Burdette Creek-Deer Creek Study Area, Values Times 100.

ALTITUDE	Aspect								Mean
	N	NE	E	SE	S	SW	W	NW	
	----------year around----------								
6500	-30	-25	-33	-33	-33	-24	-27	-28	-38
6000	-5	-10	-13	-9	1	-1	0	-3	-6
5500	9	12	14	16	16	7	-4	-1	10
5000	-21	-21	-7	14	15	11	-4	-13	-2
4500	-29	-31	4	19	25	21	6	-13	1
4000	-23	-30	-18	-8	-7	-11	-18	-24	-16
3500	8				-2	-8	-12	-10	6
Mean	-16	-11	-3	10	17	11	-7	-8	
	----------summer----------								
6500	-30	-37	-32	-36	-37	-35	-25	-37	-36
6000	2	-2	-7	-9	-3	-4	-1	0	-3
5500	8	11	9	9	6	1	-4	-1	5
5000	-5	-8	-8	5	7	8	2	-4	0
4500	-10	-10	4	5	4	1	-3	-6	-2
4000	-4	-4	-6	-1	-2	-2	-6	-5	-3
3500	13	6		-11	7	-1	-2	5	4
Mean	-4	2	1	1	9	1	-5	-2	
	----------winter----------								
6500	-15	-10	-23	-18	-17	-13	-24	-16	-21
6000	-2	-4	-4	-3	2	0	1	-3	-2
5500	5	8	9	13	15	7	-4	-1	7
5000	-21	-20	-5	16	22	16	0	-13	0
4500	-33	-37	1	18	26	24	7	-15	1
4000	-21	-31	-19	-12	-8	-11	-18	-23	-17
3500	13	22		-36	21	-15	-10	1	1
Mean	-18	-14	-4	11	19	13	-5	-11	

Table 5.--Elk Site Selection, 1970, Values Times 100. Aspect and Attitude.

ALTITUDE	Aspect N	NE	E	SE	S	SW	W	NW	Mean
				year around					
6500	-75	-41	-43	-34	-37	-36	-78	-62	-49
6000	-13	-14	-20	-13	6	-1	-8	-3	-8
5500	19	25	18	15	12	9	-4	-2	11
5000	-27	-14	-12	6	3	8	-4	-15	-7
4500	-7	-14	30	44	27	7	1	0	12
4000	-21	-33	-15	-1	-1	-14	-32	-45	-20
Mean	-10	-1	3	6	23	1	-17	-9	
				summer					
6500	-67	-37	-34	-31	-34	-34	-65	-57	-44
6000	5	5	-6	-11	1	-4	-9	5	-2
5500	9	13	10	7	6	3	-8	-8	4
5000	-11	2	-3	-2	1	4	-3	-12	-3
4500	-6	-7	17	22	5	-1	-5	1	3
4000	9	20	3	12	10	5	-7	-7	4
Mean	1	13	2	1	11	-1	-9	-10	
				winter					
6500	-20	7	-47	-29	-28	-23	-61	-17	-41
6000	-4	-4	-3	-3	11	5	-5	-6	-1
5500	13	22	16	13	8	5	-9	-3	8
5000	-31	-17	-9	13	16	22	-1	-17	-3
4500	-19	-32	20	41	33	13	4	-8	9
4000	-21	-34	-17	-4	-3	-16	-35	-44	-21
Mean	-15	2	-4	9	28	3	-11	-15	

Table 6.--Elk Site Selection, 1971, Values Times 100. Aspect and Altitude.

ALTITUDE	Aspect								Mean
	N	NE	E	SE	S	SW	W	NW	
	----------year around----------								
6500			-69	-62	-61			-71	-65
6000	-4	-5	-6	-3	13	10	11	-8	4
5500	15	15	17	18	19	12	1	3	12
5000	-11	-31	-11	1	-6	-9	-6	-6	-7
4500	-48	-37	16	24	15	11	-5	-22	-5
4000	-18	-25	-28	-7	-6	20	11	6	0
3500	-22					-13	-20	-22	-21
Mean	-24	-9	2	7	11	6	3	-4	
	----------summer----------								
6500		-66	-68	-64	-64	-54		-68	-66
6000	-1	1	-2	0	7	5	6	-5	2
5500	10	10	8	9	9	1	-5	-2	5
5000	-4	-13	-10	20	16	14	3	1	4
4500	-4	-7	-14	-15	-21	-15	-11	-2	-11
4000	-7	-10	-16	-2	-1	20	14	11	5
3500	-18	-20				-26	-23	-23	-22
Mean	0	-1	-7	-6	15	-3	-2	1	
	----------winter----------								
6500	-26	-26	-33	-27	-28	-21	-28	-26	-27
6000	-4	7	8	8	9	6	4	-7	4
5500	6	7	2	10	18	15	5	3	8
5000	-7	-25	-10	2	4	-6	1	-4	-4
4500	-52	-41	21	27	19	16	-3	-23	-4
4000	-11	-21	-37	-17	-13	15	11	8	-3
3500	-15	-23				-33	-22	-22	-23
Mean	-19	-18	4	4	10	12	3	-6	

Table 7.--Elk Site Selection, 1972, Values Times 100. Aspect and Attitudes.

ALTITUDE	Aspect N	NE	E	SE	S	SW	W	NW	Mean
				year around					
6500	-19	-33	-20	-24	-26	-28	-7	-19	-22
6000	12	-1	-7	-6	-5	-5	6	11	0
5500	7	11	14	14	7	-8	-7	1	5
5000	-27	-18	0	10	11	6	-9	-23	-6
4500	-23	-33	-11	1	34	49	37	-3	9
4000	-26	-33	-21	-14	-10	-25	-25	-27	-21
3500	16						-36	2	2
Mean	-18	-8	-3	6	6	20	-3	-4	
				summer					
6500	-15	-22	-6	-22	-27	-33	-8	-15	-18
6000	9	-2	-9	-5	-6	-2	6	11	0
5500	9	13	14	10	1	-11	-5	3	5
5000	-8	-12	-8	3	5	8	-4	-8	-3
4500	-29	-21	13	14	28	25	13	-17	4
4000	-6	-12	-8	-11	-12	-21	-16	-12	-13
3500	12	26				9	-8	11	11
Mean	-15	1	4	5	6	5	-3	-1	
				winter					
6500	-18	-22	-11	-6	-5	-2	-9	-18	-11
6000	15	1	-3	-2	0	-1	12	15	4
5500	8	7	8	10	6	-5	-5	3	4
5000	-25	-16	2	12	16	8	-6	-22	-4
4500	-23	-36	-17	-3	25	48	36	0	7
4000	-24	-38	-17	-17	-5	-20	-22	-29	-21
3500	26	59				-22	-28	10	10
Mean	-18	-9	-6	4	9	20	1	-3	

Table 8.--Elk Site Selection, 1973, Values Times 100. Aspect and Altitude.

ALTITUDE	Aspect N	NE	E	SE	S	SW	W	NW	Mean
				year around					
6500	3	0	-1	-11	-6	-7	3	-4	-13
6000	-16	-19	-17	-13	-11	-11	-8	-12	-18
5500	-7	-3	8	18	26	13	-6	-7	13
5000	-20	-22	-3	37	50	40	5	-8	13
4500	-37	-38	-19	7	25	17	-9	-28	-12
4000	-26	-28	-6	-10	-9	-24	-27	-28	-23
3500	29				-2	-2	19		25
Mean	-11	-24	-14	22	27	15	-11	-15	
				summer					
6500	-8	-23	-18	-28	-23	-19	-3	-6	-15
6000	-4	-11	-11	-18	-14	-15	-7	-10	-12
5500	2	7	4	8	6	9	2	5	6
5000	2	-10	-9	-1	6	7	12	4	3
4500	-1	-3	1	-1	2	-4	-7	-5	-3
4000	-12	-14	-3	-4	-5	-11	-13	-11	-9
3500	46			-32	22	14	23	28	26
Mean	-1	-5	-6	5	2	2	-6	2	
				winter					
6500	3	0	-1	-11	-6	-7	3	-4	-3
6000	-16	-19	-17	-13	-11	-11	-8	-12	-13
5500	-7	-3	8	18	26	13	-6	-7	9
5000	-20	-22	-3	37	50	40	5	-8	11
4500	-37	-38	-19	7	25	17	-9	-28	-9
4000	-26	-28	-6	-10	-9	-24	-27	-28	-21
3500	29	29		-36	21	10	19	16	17
Mean	-18	-30	-11	25	30	17	-12	-18	

Annual distributions of elk pellets (Tables 5-7) deviate from the overall mean in several ways that demonstrate the influence of weather and various kinds of disturbance. The winter range concentration at 5000 and 5500 feet that is very directly related to winter weather conditions. The winters of 1969-70 and 1972-73 were considered mild for western Montana while 1970-71 and 1971-72 were considered normal. Following both mild winters, but paricularly in 1973, the numbers of pellet groups at 5000 feet indicate a shift of winter range to the highest altitude permitted by winter snow depths.

Changes in summer distribution are less definitive but do appear to infer some of the known changes in elk distribution. At 6000 feet elk use increased on south and west aspects from 1970 to 1971, dropped again in 1972 except for northwesterly aspects and then declined very sharply in 1973. Considering that less than half the samples were directly affected, this pattern appears to partially correspond with the already described movement of elk out of Deer Creek, over the ridge between Deer Creek and Burdette Creek and away from the timber sale area. However, it should also noted that N and NW aspects received heavier use than other aspects in three of the four years. The exception, 1971, was the wettest of the four summers and the driest summer, 1973, was the one in which elk use of the aspects at 6000 feet declined. Thus, there is a suggestion that summer weather and the availability of moisture may have been an over-riding determinant of elk environmental selections.

WATER

It is somewhat surprising, therefore, that distance from water (Table 9) does not demonstrate a particularly strong influence on elk environmental selections. There does seem to be a tendency for areas over 1/2 mile from water to have negative values, but the year to year changes do not appear to correlate with wet and dry years. Thus, at this point, it seems reasonable to conclude that free water is not an absolute attraction in areas where the distance to water does not usually exceed one mile.

Table 9.--Elk Site Selection, 1970-1973, Values Times 100, Distance from Water (summary only).

	Year			
	1970	1971	1972	1973
Under 1/4 mile	0	0	-2	-1
1/4 - 1/2 mile	1	2	5	2
Over 1/2 mile	-2	-4	-7	-7

One possible exception to this conclusion was suggested by a previous presentation of data in which one-sixth mile was selected as the minimum distance for sorting (see 1972 annual report). With the shorter distance, a slightly higher positive value was recorded for 1970. Future analysis will examine the possibility that areas very close to water, within one-tenth mile, are especially attractive because they support permanently green vegetation and provide a potential for wallowing.

ROADS

Elk reaction to the presence of roads is, of course, one of the most important questions to be examined in this study. Table 10 presents the values derived for the four years of study to date. At first examination, it appears that reaction to roads, particularly in the first quarter-mile is extremely inconsistent. However, within the frame work of known disturbance patterns on the study area, these data do seem to fit a pattern.

In 1970, elk use of areas within 1/4 mile of roads was negative and use of areas up to two miles positive. Beyond two miles, negative values were again recorded. These negative values, however, can be pretty well discounted. Half the areas of this description are located in the bottom of Burdette Creek where negative values relate to winter range preferences rather than roads. In Deer Creek, which is not winter range, the 46 observations 2 - 4 miles from roads had a positive value 9.

Table 10.--Elk Site Selection, 1970-1973, Values Times 100, Distance from Roads.

	Year			
	1970	1971	1972	1973
Under 1/4 mile	-9	9	-7	1
1/4 - 1/2 mile	4	3	-2	-1
1/2 - 1 mile	1	3	3	-3
1 - 2 miles	9	9	-1	3
2 - 4 miles	-9	-25	4	-3
Over 4 miles	-41	-126	24	13

These 46 locations in Deer Creek were reduced to one in 1971, on the construction of a new road system throughout the drainage. Between 1970 and 1971, the number of observations under 1/2 mile in Deer Creek increased from 17 to 110 while the number over one mile dropped from 108 to 26. The result was that elk use near roads appears to increase when, in fact, the pellet distributions probably describe the failure of animals to adjust in a single year to the presence of new roads. This thesis is supported by the decline, in 1972, of elk pellet groups near roads.

In the area beyond 1/4 and under one mile, sample sizes are relatively large for all years and the evidence suggests that effects of roads on elk distribution are not particularly significant. Beyond one mile some obvious problems begin to affect the data because locations of this type are somewhat restricted to lower winter range areas in which annual variation is very much influenced by weather. The data to this point suggest that the presence of a road will depress elk use in a strip 1/2 mile wide.

COVER

As previously noted, cover data in 1973 were collected under a revised system in which tree canopy, understory canopy and dominant species were recorded (see Figure 2). The intention of this simplified system was to reduce the variety of cover-type categories to as low a number as possible. However, there were eight tree species and 21 shrubs encountered--with the result that nearly 75,000 combinations are possible. One attempt was made to sort on all possible combinations, but the resulting output exceeded the capacity (400) of the output matrix and it was obvious that meaningful interpretation would be virtually impossible.

For the initial sort, then, trees were treated independently of other vegetation. Table 11 presents the elk selection preferences based on tree density alone. Tree species within densities were then calculated by combining all observations in which a species occurred irrespective of the other species present.

Table 11.--Elk Site Selection, 1973, Values Times 100, Tree Density Combined and by Species.

Canopy Cover		Pellet Combinations		
		All	Summer	Winter
All trees	- under 25%	9	2	10
	25 - 75%	-2	-2	-1
	over 75%	-7	2	-9
Lodgepole pine	- under 25%	-4	-9	-4
	25 - 75%	-10	-6	-8
	over 75%	-6	7	-10
Ponderosa pine	- under 25%	18	7	15
	25 - 75%	4	0	3
	over 75%	-9	-7	-6
Douglas fir	- under 25%	4	-2	9
	25 - 75%	1	1	0
	over 75%	-8	0	-6

The upper part of Table 11 establishes (1) a definite elk preference for areas in which tree canopy densities are below 25 percent and (2) an avoidance of areas with canopy over 75 percent. This would be an extremely surprising relationship if a ready explanation were not available. Such an explanation is provided by the fact that old and very old pellet groups are primarily responsible for the relationship. Preferred winter range does, in fact, have very low tree densities. Moreover, Ponderosa-pine and Douglas-fir are the more common trees on ranges, and for both species the relationship is consistent.

Pellet combinations indicating summer distribution of elk are less definitive, but still suggest some important relationships. The averages for all tree species combined indicate no specific selection for tree density during the summer. However, the breakdown by tree species shows that lodgepole pine in dense canopy is selected as a preferred cover.

Table 12.--Elk Site Selection, 1973, Values Times 100, Shrub Density Combined and by Species, All Pellets.

Shrub Canopy	All	Shrub Species							
		Sasc	Acgl	Aler	Amal	Ceve	Phma	Mefe	Syal	Vame
Under 25%	2	-19	18	-23	7	22	10	16	-28	2
25 - 75%	-2	-1	-1	-19	0	26	2	0	-17	-16
Over 75%	4	29	10	-6	46	19	9	-3	-113	-8

Table 12 summarizes elk preferences for site based on shrub understory density. Averages for all shrubs suggest that this vegetation is considerably less important than trees in determining site preferences by elk. Interpretation is further complicated by the fact that some of the sample sizes available for Table 12 are extremely small when separation by shrub species is attempted. Moreover, there are some obvious ecological relationships which may tend to obscure or emphasis relationships. Ceanothus velutinus, for example, has very high positive values in all densities. This suggests a strong attraction for elk, but it also confirms the fact that Ceanothus has a distribution which is very much concentrated on southerly aspects near 5000 feet. Is the winter range attractive because of aspect and altitude or because of the forage resource?

The only obvious answer is that both factors are involved, and in this respect it is notable that those shrub species with high palatability have positive values where crown canopy is over 75 percent while species with low palatability have negative values. The single obvious exception, Physocarpus, is very often associated with a variety of palatable species on winter range areas.

The available data suggest a wide range of additional analyses, none of which have been completed for this report. We have in preparation, for example, a series of ecological equivalence compansons for tree and shrub species and several additional tabulations of tree and shrub species preferences by elk on different aspects and altitudes. At this point, however, it has become very obvious that the inter-relationships among variables are too strong to allow independent presentations of partial analyses.

SUMMARY AND CONCLUSIONS

Distribution of elk, as indicated by pellet groups continued to decline in Deer Creek during 1973. Changes in elk use of other drainages, however, were apparently controlled by winter weather rather than the disturbance associated with the timber sale. The winter of 1972-73 was an extremely mild winter and distribution of pellets throughout the area indicated a shift to higher altitudes and to aspects which would normally be unused during the winter period.

Initial analyses of environmental preference pattern confirms the importance of midslope habitat, winter concentrations on southerly aspects and demonstrate annual variations associated with weather and the Deer Creek timber sale. Water did not appear to be particularly definitive in determining site selection by elk although there is some suggestion that areas over 1/2 mile from water are less desirable.

With respect to roads, there was a fairly strong avoidance of sites within 1/4 mile. However, elk use of areas beyond that distance was only slightly influenced and other factors, particularly weather, may be controlling.

Analyses of elk use of different kinds of cover produced some unexpected results. It is shown that low density tree cover is preferred during the winter--specifically in Ponderosa-pine and Douglas-fir types. Summer use, however, is much more evenly distributed and a positive preference value for dense lodgepole pine is indicated. Shrub density was much less definitive for elk and the major finding is a suggestion that dense shrub stands of patatable species are preferred. Future analysis will attempt definition of tree and shrub combinations as well as separation of topographic influences.

Submitted By: L. Jack Lyon

Job II-A
Procedures B-2, B-3.a, and B-3.b
ELK HARVEST, DISTRIBUTION AND FOOD HABITS
Progress Report for the Period
Jan. 1, 1973 - Dec. 31, 1973

INTRODUCTION

The Burdette Creek Study Area consists of several steep-sided drainages tributary to Fish Creek and Petty Creek. The area between Lupine and Wig Creek is relatively open as a result of the 1917 forest fire. It is unroaded except for the roads at the ridge top, in Owl Creek, and in the Fish Creek bottom. This is the main winter range for at least two elk herd segments. One of these is more or less resident in the study area, and the other segment migrates to the winter range from the Idaho divide area.

The Deer Creek drainage in the northwest portion of the study area was heavily timbered, and the National Forest portion was unroaded, at the start of the study, but it has now been heavily roaded and logged.

The remainder of the study area is mostly heavily timbered, with only one main road which starts up the South Fork of Petty Creek, follows the central ridge between Fish Creek and Petty Creek, and then goes down the Ed's Creek ridge. A few short roads enter the lower ends of some drainages.

Checking stations were operated for the fourth successive year in 1973 at three locations which intercepted hunter traffic coming from the Burdette Creek study area and adjacent areas. Data from the Frenchtown and Lolo checking stations in 1963 are also available and are believed to be fairly comparable.

Hunter and guide contacts to obtain information on harvested elk not checked through the checking stations were not made in 1973, therefore yearly comparisons are based only on elk checked or reported at the stations.

The student project utilizing radio tracking to monitor movements of elk in and near the study area, begun in 1972, was continued through 1973 and provided considerable data on movements and use of habitat types.

METHODS

The three checking stations were operated at the same locations as in 1970-72. The Lolo and Fish Creek stations were run every day during the eleven day either-sex season, and on weekends thereafter until the close of the bull season. The Petty Creek station was run only on week-ends. The number of hunters and the sex, age and locations of elk and deer kills were recorded. Jaws were collected whenever posible to provide more accurate age determinations. Jaws with intact incisors, and some extracted incisors, were submitted to the Bozeman Fish and Game Department Laboratory for age determination by incisor sectioning. These determinations are not yet available.

Occasional flights and ground surveys were made to document distribution, numbers, and sex-age composition of the elk herd.

Elk were trapped in the Wig Creek trap, ear-tagged, collared and fitted with radio transmitters in connection with the graduate student elk movement study. Periodic flights and ground trips were made to monitor movements of the radioed elk. Locations where elk were observed were visited on the ground to obtain habitat type data.

FINDINGS AND DISCUSSION

Hunting Pressure

The 1973 elk hunting season in Hunting District 230, which includes the study area, was October 21-31 for either sex. There was no early bull season as there was in 1971 and 1972, but there was a late bull season November 1-18. This bull season was six days longer than in 1972.

Hunting pressure by various periods for the total area covered by the checking stations is shown in Table 1. The total number of hunters checked in 1973 was 4541. This was considerably higher than in prior years, reflecting the effects of high meat prices and the new compulsory checking station law. The distribution of hunting pressure by time periods was similar to 1972, except that hunter participation remained high through the last weekend of the season in 1973, while it declined greatly by the end of the season in 1972. More than 70 per cent of the elk harvest was taken during the first eight days of the season.

Table 1. Checking station data by time periods from the Lolo, Fish Creek, and Petty Creek stations, 1970 - 1972.

Period	No. Hunters				Elk Checked			
	1970	1971	1972	1973	1970	1971	1972	1973
Early bull season								
1st day	-	204	120	-	-	7	15	-
2nd day	-	208	141	-	-	13	7	-
3rd day	-	33	123	-	-	8	0	-
Regular season								
1st Sunday	433	405	273	608	22	9	23	10
1st Week *	285	-	391	898	50	-	7	58
2nd weekend	509	401	516	935	13	5	15	23
2nd week *	86	-	64	47 1/	5	-	1**	3 1/
3rd weekend	370	419	341	728	6	15	4	16
3rd week *	73	-	-	-	12	-	-	-
4th weekend	339	651	340	702	2	7	3	11
4th week *	61	-	-	-	1	-	-	-
5th weekend	209	272	37	623	1	1	0	5
6th weekend	291	302	-	-	6	3	-	-
Last weekend	183	242	-	-	2	2	-	-
Totals	2839	3137	2346	4541	120	70	75	126

* week days only

** the either-sex season ended on Tuesday, Oct. 31

1/ the either sex season ended Wednesday, Oct. 31. Checking during the week was done only Monday at the Lolo Creek station

Elk Harvest

The area covered by the checking stations was much larger than the study area itself, so it was divided into eight units, consisting of the study area and surrounding segments (Fig. 1). Elk harvests from these units, and from portions of the study area, as well as total harvests are shown in Table 2. Total checked kills were 116 in 1963, 127 in 1970, 89 in 1971, 77 in 1972 and 128 in 1973. The 1973 harvest was about the same as in 1963 and 1970. Lower numbers of elk were checked in 1971 and 1972, probably due to a combination of fewer elk in the area, and mild weather during the hunting season. The early bull season in these two years may also have reduced the kill by "spooking" the elk and making them less vulnerable to hunters during the general season.

Table 2. Geo graphic distribution of the elk harvest checked at the Lolo, Fish Creek and Petty Creek stations.

	1963		1970		1971		1972		1973	
	Elk Checked		Elk checked		Elk checked		Elk Checked		Elk Checked	
Area of Kill	No.	%	No.	%	No.	%	No.	%	No.	%
S. Lolo Creek	7	6	6	5	9	10	6	8	15	12
N. Lolo Creek	29	25	13	10	13	15	16	21	14	11
W. Fish Creek	5	4	8	6	13	15	5	6	7	5
N. Fk. Fish Creek	28	24	52	41	20	22	35	45	54	42
Rock Cr-Meadow Cr.	3	2	4	3	2	2	0	0	3	2
Study Area										
Wagon Mtn Rd.	1		3		0		1		1	.8
Sullivan Cr.	-		-	-	-	-	-	-	1	.8
Lupine Cr.	0	0	5	4	6	7	1	0	0	
Burdette Cr.	6	5	5	4	2	2	1	1	2	1.6
Hyde Cr.	0		0	2		0		0		
Owl Cr.	0		3		1		0		1	.8
Wig Cr.	0		3		0		1		2	1.6
Lion Cr.	0		1		0		0		0	
Deer Cr.	7	6	4	3	2	2	0	0	2	1.6
S. Fk. Fish Cr.	1		1		-		-		0	
Eds Creek	0		1		1		0		1	.8
Gus Creek	0		0		1		0		0	
Johns Creek	1		0		0		0		0	
S. Fk. Petty Cr.	0	0	7	6	1	1	0	0	2	1.6
Sub-Total	16	14	33	26	16	18	4	5	12	9
N. Fish - W. Petty	0	0	2	2	5	6	3	4	4	3
E. Side Petty	3	3	6	5	8	9	8	10	14	11
Misc. Lolo Cr.	2	2	1	1	3	3	0	0	0	-
Misc. Fish Cr.	9	8	0	0	0	0	0	0	4	3
Misc. Petty Cr.	14	12	2	2	0	0	0	0	1	1
Grand Total	116	100	127	100	89	100	77	100	128	100

Figure 1. Elk harvest segments in area checked by Lolo Creek, Fish Creek and Petty Creek checking stations

Ⓧ - Checking station location
1 - Quartz Creek-Meadow Creek
2 - North Fork Fish Creek
3 - West Fish Creek
4 - North Fish Creek
5 - Study Area
6 - East Petty Creek
7 - North Lolo Creek
8 - South Lolo Creek

The total checked harvest declined 34 per cent between 1970 and 1972, but bounced back in 1973 to the 1970 level. The elk harvest from the study area itself declined 73 per cent between 1970 and 1972 and increased only slightly in 1973, so that it was still 57 per cent below the 1970 harvest. Elk harvest from the relatively open, but mostly unroaded Lupine-Burdett-Wig Creek area declined 81 per cent between 1970 and 1972, and was 69 per cent below the 1970 level in 1973. A progressive decline in the number of elk taken from the Deer Creek drainage which was logged during the period 1971-1973, was indicated. There the checked harvest was seven in 1963, four in 1970, two in 1971 and none in 1972. Two were killed there in 1973, possibly indicating a movement of elk back into the area.

Elk harvests from the various harvest segments covered by the checking stations also changed in distribution. The harvest from the study area declined from 26 per cent of the total checked harvest in 1970 to only five percent in 1972. In 1973 it comprised nine per cent of the harvest. The North Fork Fish Creek harvest comprised 42 per cent of the total checked harvest which is about normal.

Table 3 shows the sex-age composition of harvested elk checked from the study area vicinity. The 1973 figures are 16 yearling bulls, 49 older bulls, 47 cows and 16 calves. The number of bulls taken exceeded the number of cows every year except in 1963 when there was a long either-sex season. The proportion of yearling bulls in relation to older bulls was lower in every year than in more heavily-harvested herds. The 1973 ratio was 33 yearling bulls per 100 older bulls. The proportion of calves in 1973 was 34 calves per 100 cows, which represents a relatively high proportion of calves for the area compared with 1970 and 1971.

Table 3. Sex-age composition of harvested elk checked from the vicinity of the Burdette Creek Study Area.

Sex-age Class and Ratios	1963	1970	1971	1972	1973
Yearling Bulls	10	18	14	6	16
Older Bulls	34	43	50	39	49
Total Bulls	44	61	64	45	65
Cows	58	54	34	23	47
Calves	19	11	10	8	16
Total Elk	121	126	108	76	128
Yearling/100 Older Bulls/100 Cows	29	42	28	15	33
Calves/100 Cows	76	113	188	196	138
	33	20	29	35	34

Harvested elk were age-classified to the year whenever possible. These data are shown in Table 4. All elk checked at the three stations were included, rather than just those from the study area, to increase the sample size. The large numbers of unclassified adults reduce the value of the data somewhat, since these detract more from some age classes than others. Age classes that

are easily identified by game checkers, and are probably represented in their true proportions in the total checked harvest, are calves, yearling bulls, and old animals. Also, since the majority or the unclassified animals would be in the "prime" class, a somewhat exaggerated estimate of the numbers and percentages in the prime class can be made by adding together the "prime" and "unclassified adult" columns. Accordingly, elk in the prime class would be somewhat less than the following percentages: 65 per cent in 1963, 58 per cent in 1970, 66 per cent in 1971, 71 per cent in 1972, and 61 per cent in 1973. Yearling bulls comprised somewhat more than 19 per cent of the male harvest in 1963, 30 per cent in 1970, 20 per cent in 1971, 12 per cent in 1972, and 20 per cent in 1973. Old-aged elk (smooth 1st molar) comprised at least four percent of the checked harvest in 1973 (one percent of the males and seven per cent of the females). Calves comprised ten percent of the male and 16 percent of the female harvest.

Table 4. Age composition by year class of elk killed in the vicinity of the Burdette Creek study area.

Year	Sex	½ Year		1½ Year		2½ Year		Prime		Old		Uncl. Adult		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1963	Male	9	17	10	19	6	11	6	11	0	0	22	42	53	100
	Female	10	15	3	4	3	4	3	4	1	2	48	71	68	100
	Both	19	16	13	11	9	7	9	7	1	1	70	58	121	100
1970	Male	5	8	18	30	7	11	25	41	4	7	7	11	66	100
	Female	6	11	3	6	8	15	17	31	1	2	25	46	60	100
	Both	11	9	21	17	15	12	42	33	5	4	32	25	126	100
1971	Male	5	7	14	20	6	9	22	31	0	0	22	32	69	100
	Female	5	13	1	3	4	10	15	38	1	3	13	33	39	100
	Both	10	9	15	21	10	9	37	34	1	1	25	32	108	100
1972	Male	4	8	6	12	3	6	20	41	0	0	16	33	49	100
	Female	4	15	2	7	2	7	3	11	1	4	15	56	27	100
	Both	8	11	8	11	5	7	23	30	1	1	31	41	76	100
1973	Male	7	10	14	20	7	10	33	48	1	1	7	10	69	100
	Female	9	16	5	9	2	4	11	19	4	7	26	45	57	100
	Both	16	13	19	15	9	7	44	35	5	4	33	26	126	100

Population Trend and Composition

Winter elk populations in the study area have not varied much. Aerial counts were 151 in April, 1971; 133 in December, 1971; 141 in April, 1973; and 150 in December, 1973. Winter herd composition data were obtained by ground counts in Burdette Creek on March 18, 1974. A sample of 91 different elk indicated a herd composition of 25 bulls and 38 calves per 100 cows. These ratios are similar to those of previous years (Table 5).

Table 5. Classified counts of elk in Burdette Creek area

Period	Bulls			Cows	Calves	Total Elk	Sp./100 B.A.	Bull/ 100 Cows	Calves 100 Cows
	Spike	B.A.	Total						
Fall-Winter,1970-71	18	42	60	340	101	501	43	18	30
Fall-Winter,1971-72	40	49	89	309	128	526	82	29	41
July-September, 1972	3	9	12	60	25	97	33	20	40
March-April,1973	2	6	8	37	14	59*	33	22	38
June-November,1973	6	19	25	94	40	159	31	24	42
March, 1974	6	8	14	56	21	91*	75	25	38

* Unduplicated samples

Movements

Eleven elk were instrumented with radio transmitters, contained in neck collars, while on winter range in 1972 and 1973 (Zahn, 1974). Three of these were tranquilized by shooting them with a dart gun from a helicopter in the Burdette Creek drainage, and eight were trapped in a corral-type trap in Wig Creek. Details of trapping, marking and final locations are shown in Table 6.

The three captured by helicopter and tranquilizer gun stayed in the area between Fish Creek and Petty Creek well into the summer when the transmitters failed. Their summer range is presumed to be in this area (Figure 2).

Table 6. Summary of instrumented elk data

Elk	Sex	Approx. age	Date & location tagged	Date & location of last radio fix	Summer-fall area (sq. mi.)	Max. distance moved (mi.)
A	F	adult	4-27-72 Burdette Cr.	6-9-72 W.Fk.Petty Cr.[1/]	?	?
B	F	adult	3-24-72 Burdette Cr.	8-11-72 John's Cr.	2.8	5.0
C	F	adult	4-20-72 Burdette Cr.	8-11-72 Burdette Cr.	8.1	4.5
D	M	2	5-31-72 Wig Cr.	8-22-72 shot 10-31-72 Wapito Pt.,Idaho	16.0	13.0
1	F	3-4	4-11-73 Wig Cr.	12-5-73* Owl-Wig Cr.	5.9	11.0
2	M	1	5-1-73 Wig.Cr.	10-3-73 shot 10-6-73 Kelly's Sister,Idaho	35.0	20.0
3	F	8+	5-1-73 Wig Cr.	12-5-73* Upper Wig Cr.	4.9	10.0
4	F	2	5-1-73 Wig Cr.	12-5-73** Burdette Cr.	19	8.5
5	F	3-4	5-1-73 Wig Cr.	11-13-73 Surveyor Cr.	4.3	6.0

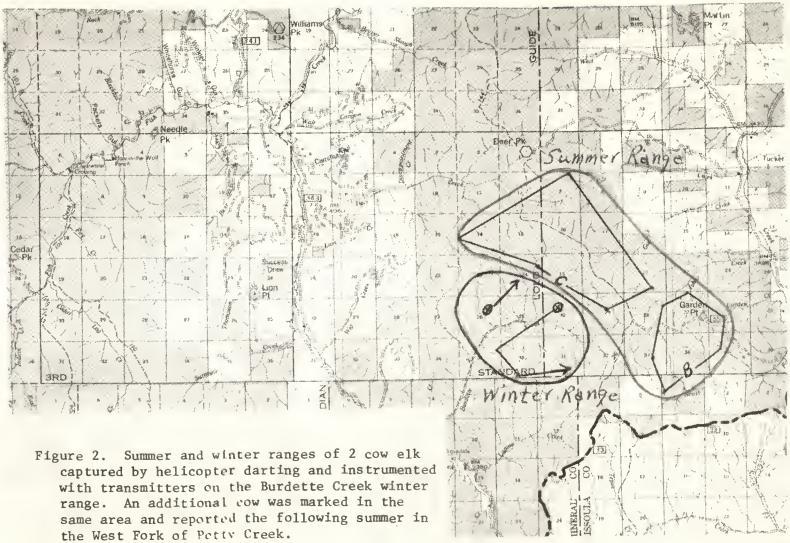


Figure 2. Summer and winter ranges of 2 cow elk captured by helicopter darting and instrumented with transmitters on the Burdette Creek winter range. An additional cow was marked in the same area and reported the following summer in the West Fork of Petty Creek.

Elk	Sex	Approx. age	Date & location tagged	Date & location of last radio fix	Summer-fall area (sq. mi.)	Max. distance moved (mi.)
6	F	4-5	5-2-73 Wig Cr.	11-13-73* Lupine Cr.	3.3	11.0
7	F	3-4	5-13-73 Wig Cr.	12-11-73* Burdette Cr.	7.1	10.0

* Radio operating as of 5-1-74
** Radio removed and replaced 4-5-74
1/ Reported visual observation

The seven trapped in Wig Creek moved to summer range west of Fish Creek. The five cows spent most of the summer in the area bounded by the Idaho state line, the Middle Fork of Indian Creek, Lower Cedar Log Creek, the head of Thompson Creek, lower Surveyor Creek, lower Montana Creek, and Cache Creek. However, cow No. 4 moved back and forth between summer range on Montana Creek and winter range on Hyde and Owl Creeks three times during the summer. Cow No. 6 was located about three miles inside of Idaho near the head of the Middle Fork of Kelly Creek once during the summer. Their summer and winter ranges are shown in Figure 3.

Elk No. 2, a spike bull, displayed very erratic movements between the winter range, upper Cache Creek, the Thompson-Cedar Log Creek ridge, Surveyor Lake, and Irish Basin. Between late August and early September it moved into the upper Kelly Creek drainage in Idaho and was shot by a hunter north of Kelly's Sister Mountain in early October, 1972. One other marked spike was also shot by a hunter.*

A mature bull elk (D) made a direct move from Wig Creek to just south of Fish Lake, Idaho, between May 31 and July 28. He moved northwest to Siam Creek (Idaho) by late August and then southward to Moose Creek (Idaho), where he was shot by a hunter October 31, 1972 southeast of Wapito Point.

Use of Habitat Types

Elk observations in relation to habitat types are contained in the theses of Joseph Bohne and H. M. Zahn. Bohne's thesis was not available at the time of this writing. Zahn documented use of habitat types by radioed elk in 1973 (Zahn, 1974).

During the winter, open, south-facing, grassy slopes with sparse timber cover (DF/Agsp, DF/Syal types) were heavily used, and elk moved only minimal distances during deep snow periods. As the snow melted, elk moved more widely over the winter range, including its lowest portions during green-up of vegetation. During May, use of open slopes declined, and use of open timber types (DF/Phma, DF/Xete) increased. By June, most elk had dispersed to summer-fall range and made greater use of denser timber types (AF/Clun, AF/Mefe and AF/Xete). During the period July-October, from 31 to 55 percent of all elk locations were in the AF/Mefe type. The heavy snowstorm which occurred about November 1, 1973, drove most of the elk from

* This bull was trapped at Wig Creek May 31, 1972. It was ear-tagged and collared but not radioed. It was shot on upper Montana Creek September 16, 1972, during the early bull season.

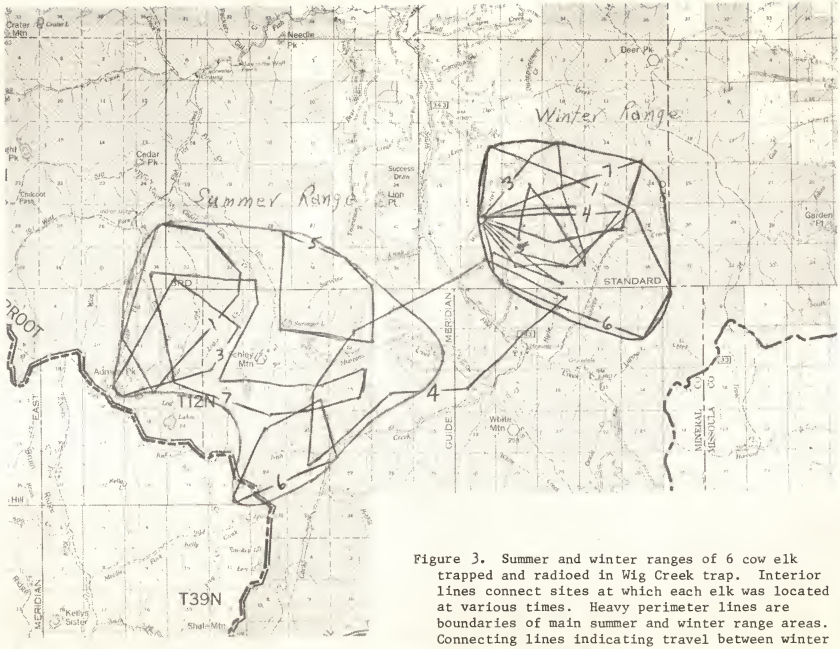


Figure 3. Summer and winter ranges of 6 cow elk trapped and radioed in Wig Creek trap. Interior lines connect sites at which each elk was located at various times. Heavy perimeter lines are boundaries of main summer and winter range areas. Connecting lines indicating travel between winter and summer ranges are not shown.

their summer range. In November, 92% of elk locations were in the DF/Phmd and DF/Xete types. By December, 86 percent of elk locations were in the DF/Agsp, DF/Syal and DF/Phma types on the winter range.

Use of heavy timber types was greatest in August (81% of locations were in canopy cover greater than 60%). Aspect appeared to influence elk use considerably. During the period May-December 25% of locations were on east slopes and 24% in drainage bottoms (mostly in AF/Clun type). In December, 57% of locations were on south slopes; locations during other winter months are presumed similar. However, from May to November only 2% of locations were on south slopes. All other aspects (N, NE, SE, SW, W, NW, and ridges) each provided less than 10% of the locations.

The results of the study indicated that the marked elk made little use of clearcuts. No locations of radioed elk were obtained from Deer Creek which was logged during the study period. One cow elk (No. 5) appeared to use a number of clearcuts in the upper Surveyor Creek drainage, an area of dense timber with few natural openings. Although she was never actually located in a clearcut, the fact that she was found within 100 - 200 yards of clearcuts on several days, combined with fresh elk signs in the edges of the cuts, suggested that she was using them. On one occasion another elk (unmarked) in the same vicinity was observed to enter one of the clearcuts and feed on some shrubs. There is a possibility that clearcuts in heavy forest may hold some elk which would otherwise migrate to higher, more open, sub-alpine summer range.

LITERATURE CITED

Zahn, Helmut M. 1974. Seasonal Movements of the Burdette Creek Elk Herd. Unpub. M. S. thesis, University of Montana, Missoula. 71 pp.

Submitted by: Reuel G. Janson

JOB II - B
LONG TOM CREEK STUDY
Procedure A.1
Vegetation Analysis

INTRODUCTION

Vegetation analysis for the Long Tom Creek Study area was initiated in 1972 and completed during the summer of 1973. The study area has been described in other reports of this series.

COVER TYPE CLASSIFICATIONS

Methods

The basic sampling and cover study was described and analyzed in the July 1973 report for Job II A, Procedure A.1., Burdette Creek-Deer Creek. The following report follows the format established for Burdette Creek-Deer Creek and is very much condensed except for results and conclusions.

Results

The initial selection of cover types by aspect was based on interpretation of 10 points per aerial photograph on the 57 photos required for stereo coverage of the Long Tom Study area. A total of 560 points were classified as shown in Table 1. The most interesting aspect of this presentation is the extremely low number of sample plots on which tree crown canopy exceeds 75 percent. In the Burdette Creek and Sapphire Mountain study areas, 20 to 50 percent of all plots were categorized B3, but Long Tom Creek had only 1 percent of trees with canopy this dense. It is also notable that just a single sample point was classifed M3, wet meadow; and only 7 additional points were classified with M in the understory. This seemed surprising in terms of the apparent acreage of wet meadow in the area and the fact that foot routes in the 14 subdivisions of the area averaged one-third in "wet" types.

Table 1.--Condensed summary of cover types by aspect. Long Tom Study area

Cover types	Aspects									SUM
	U	1	2	3	4	5	6	7	8	
B3	-	1	4	1	1	-	-	-	-	7
B3F[1]	2	10	19	9	8	2	2	6	17	75
B3E[2]	-	2	2	1	-	-	1	-	-	6
B2F[3]	4	4	9	10	19	8	7	8	4	73
B2EF[4]	15	22	33	32	52	23	26	28	44	275
B2CF and B2CK	1	3	4	2	3	7	4	6	8	38
B2K and B2KR	-	-	5	4	8	5	3	4	1	30
B1E[5]	1	-	-	1	3	3	1	-	2	11
B1K and B1KR	-	1	-	4	1	4	6	1	1	18
B1CM and B1CF	1	1	-	-	2	-	-	3	1	8
Other B1	1	-	1	-	-	1	1	-	-	4
C3F	-	-	-	-	-	-	-	-	1	1
C2	1	1	-	-	-	1	1	-	-	4
C1	-	1	-	-	1	-	-	1	-	3
M3	-	-	-	1	-	-	-	-	-	1
K3	-	-	1	1	2	-	1	1	-	6
SUM	26	46	78	66	100	54	53	58	79	560

1/ B3F includes B2BF, B1BF

2/ B3E includes B3EF, B3EM

3/ B2F includes B2FT, B2FR

4/ B2EF includes B2E, B2EK, B2EM, B2M

5/ B1E includes B1EF, B1EK, B1EM

FIELD SAMPLES

On-the-ground samples of representative points was mostly completed during the summer of 1972. Using the summary presented in Table 1, sample plots were selected from the types most often represented and from all aspects on which these types occurred. During 1973, an additional sample of four wet meadows was selected to bring the total number of plots to 46.

Methods

Sampling techniques are described in the 1973 annual report. Summary data giving totals by vegetation class for the 46 sample areas are presented in Table 2. Species tabulations are also available but are not presented in this report.

COVER TYPES

In common with the Burdette and Sapphire study areas, the number of samples available for constructing a prediction model for cover is too low to be considered definitive. The problem is further compounded for Long Tom Creek in that nearly 50 percent of all classified points were of a single type (B2EF) and 75 percent of all points were of three types (B2EF, B3F, and B2F). It is also significant that shrubs were only recorded in 9 of 46 samples.

One sample of type B3 was taken. The estimated tree basal area 589 dm^2/.01H is somewhat higher than the 388 of Burdette Creek and 409 for the Sapphires. However, basal areas for all other classified types also averaged higher in the Long Tom sample and it is suspected that the quality of photographs available for this study area was enough different that the classification of points is not really comparable among areas.

Six samples of type B3F had a mean basal area 494 dm^2/.01H (S = 98). Although found on all aspects, the type seems to be limited by xeric conditions on south and west slopes and the model (Table 3) does not show B3F occurring on these aspects.

B2F (including B2CF) was represented by eight samples with mean basal area 450 dm^2/.01H (S = 104). Deviations from the mean suggest a relationship to aspect, and the model is based on a running mean derived from adjacent aspects.

B2EF is based on 12 samples with mean 363 dm^2/.01H (S = 158). In addition to the lesser basal area as compared to B2F, this type is characterized by a high density of small trees beneath the overstory. Apparently, the vegetation identified as E (tall shrubs) on the aerial photographs was, in fact, small trees with a mean density of 385 stems/.01H (S = 424). In both layers of vegetation, the relationship with aspect has been smoothed with a running mean.

Table 2.--Cover types; tree basal area and tree and small tree density; shrub density, crown area and crown volume; herbaceous area and volume; aspect and altitude; 46 sample areas from Long Tom Creek

Stand No.	Cover Classification	Tree		Small Tree	Shrub			Herbaceous		Aspect	Altitude
		Dens	B.A	Dens.	Dens	Area	Vol	Area	Vol		
18	B3	547	587	178	-	-	-	300	296	NE	7600
6	B3F	388	453	-	-	-	-	582	812	NW	7400
19	B3F	328	472	-	-	-	-	750	858	NE	7600
35	B3F	160	604	-	-	-	-	443	358	SE	8100
22	B2BF	234	591	89	-	-	-	733	925	NE	7600
2	B1BF	146	337	-	-	-	-	607	767	E	7900
1	B3FF	439	504	133	-	-	-	600	813	N	7200
3	B2F	244	438	44	-	-	-	724	788	E	8000
27	B2F	120	423	-	-	-	-	675	512	S	8300
16	B2F	104	600	-	-	-	-	967	1982	N	8500
4	B2F	338	377	-	-	-	-	518	679	W	7400
23	B2FR	120	444	-	-	-	-	340	437	SE	8000
24	B2CF	276	267	-	2	3	9	484	571	NW	6600
30	B2CF	509	559	267	-	-	-	723	654	NE	8200
29	B2CF	248	492	222	-	-	-	675	846	S	8200
5	B2EF	207	482	89	18	23	12	608	508	NW	7600
26	B2EF	136	610	-	-	-	-	758	683	S	7800
32	B2EF	380	257	489	-	-	-	942	1729	W	7800
17	B2EF	832	393	622	-	-	-	874	1269	NE	7400
14	B2EF	981	255	578	4	1	T	625	821	SW	7500

Table 2 (continued)

Stand No.	Cover Classification	Tree Dens	Tree B.A	Small Tree Dens.	Shrub Dens	Shrub Area	Shrub Vol	Herbaceous Area	Herbaceous Vol	Aspect	Altitude
13	B2EF	493	354	1556	9	2	1	800	1146	N	7800
12	B2EF	293	563	266	-	-	-	958	1468	N	8000
20	B2EF	205	555	311	-	-	-	683	912	-	7900
21	B2EF	316	426	267	-	-	-	717	1017	SW	7400
9	B2EF	363	287	222	-	-	-	851	1021	SE	7500
10	B2EF	212	454	400	-	-	-	817	1196	E	8200
7	B2EF	88	47	133	36	14	8	724	1150	SE	7100
34	B2EK	36	229	-	-	-	-	624	1483	S	7800
25	B2K	52	354	-	-	-	-	725	1350	SW	7300
28	B2K	76	291	-	13	1	T	875	1217	SE	7800
40	B2K	24	164	-	-	-	-	882	1412	NE	7700
11	B1CF	174	335	-	-	-	-	875	1087	SE	8300
8	B1K	12	185	-	8	4	2	525	1437	SW	7100
33	B1K	56	43	-	-	-	-	650	1237	E	8000
15	C2EF	407	240	-	-	-	-	550	562	S	7400
38	K3	4	2	44	18	2	2	992	892	SE	7300
36	K3	-	-	-	-	-	-	950	1512	SW	7800
31	K3	-	-	-				917	867	E	8300
39	K3	-	-	-	13	9	8	932	1612	W	6700
37	K3	-	-	-	-	-	-	758	825	SE	7700
43	M3	-	-	-	-	-	-	883	2187	-	8500
44	M3	-	-	-	-	-	-	958	2029	-	8000
45	M3	-	-	-	-	-	-	808	1655	-	8100
46	M3	-	-	-	-	-	-	983	1892	-	8200
41	Clearcut	-	-	-	-	-	-	367	212	NE	7800
42	Park	-	-	-	-	-	-	841	525	NE	7800

Table 3.--Prediction model for tree basal area and small tree density

Cover Type	Aspect							
	N	NE	E	SE	S	SW	W	NW
tree basal area								
B3		589						
B3F	494	494	494	494				494
B2F	475	532	480	447	440	417	353	415
B2EF	445	435	338	347	309	339	360	399
B2K			260	260	260	260		
B1-			188	188	188	188		
small tree density								
B2EF	541	644	400	193	147	304	334	496
vegetal cover percentage								
K3			91	91	91	91	91	
M3	91	91	91	91	91	91	91	91
herbaceous volume								
K3			1142	1142	1142	1142	1142	
M3	1941	1941	1941	1941	1941	1941	1941	1941

B2K was represented by only four samples with mean basal area 260 dm^2/.01H. The distribution of samples suggests that full development of this type will be detected primarily on south and east aspects as indicated in the model.

B1- is only represented by three samples with mean basal area 188 dm^2/.01H. This type also seemed to be expressed on south and east aspects as indicated in the model.

The single sample of C2 was taken on a south aspect, but the type is so poorly represented in the study area that it is not included in the model.

Five samples of dry grassland (K3) averaged 91 percent vegetation cover and 1142 dm^3/.01H herbaceous volume (S = 386). The model has been constructed to suggest that this type is probably not found on northerly aspects.

Wet meadows (M3) also averaged 91 percent vegetal cover, but the herbaceous volume on the four samples averaged 1941 dm^3/.01H (S = 225). This is nearly 70 percent more vegetation than produced on the dry meadow types.

In addition to the vegetation sample on classified points, one paired sample of a clearcut and adjacent park was obtained. Both areas were grazed by cattle, and the recorded herbaceous volume was lower than for any type except the closed canopy forest (B3). Cover on the clearcut was less than half (37 percent) that in the park (84 percent). Of the 41 species recorded, only 13 occurred in both situations. Thirteen species were found exclusively in the cut and 15 were found only in the park. Vegetation in park was considerably more homogenous, however. Thirteen species were found in 50 percent or more of the sample plots as compared to two species in the clearcut. On the basis of this sample, it appears unlikely that clearcutting would lead to the conversion of forest to parks. On the other hand, 13 of the 16 most frequent species in the park and 6 of 11 most frequent species in the cut are virtually exclusive to the types. Nonselective grazing pressure would certainly tend to reduce this difference between types and can probably be considered a pressure toward uniformity.

HABITAT TYPES

Each of the 40 sampled upland sites was classified to habitat type by personnel of Project FS-INT-1205. In addition, Dr. Stephen Arno spent several days in the area compiling observations on habitat types by aspect and altitude. As a result of combining these two sources of information, a habitat-type model applicable to Long Tom Creek was constructed (Figure 1).

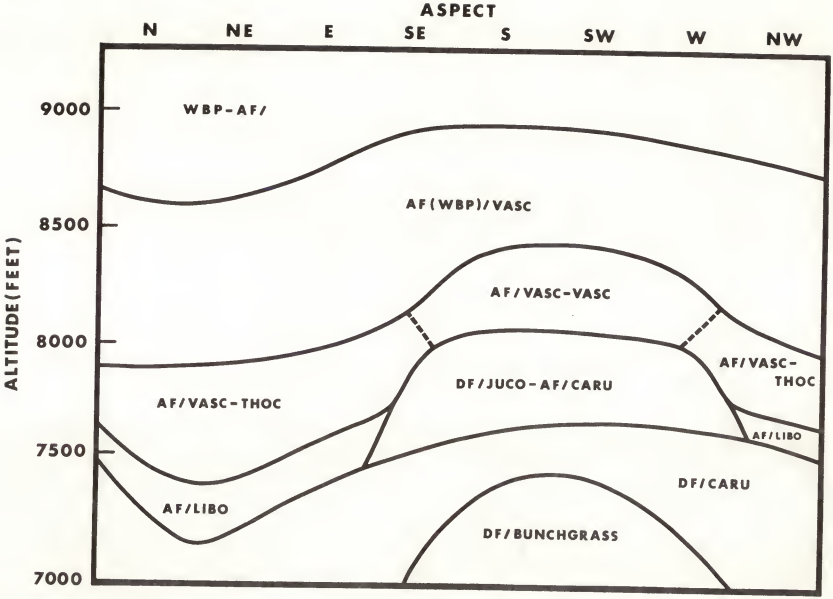


Figure 1. Habitat type model for Long Tom Creek.

Table 4.--Species frequencies recorded in 0.SM^2 vegetation plots, clearcut and adjacent natural park, Long Tom study area

Species	Frequency	
	Clearcut	Park
Achillea millefolium	20	100
Agoseris glavca	5	15
Androsachae septentrionaus		25
Antennaria anaphaloides		35
A. rosea		20
Arenaria congesta		75
Arnica cordifolia	45	
Aster conspicuous	30	20
Bromus carinatus	65	25
Calochortus eurycarpus		10
Carex concinnoides	10	
C. geyeri	30	
C. rossii	55	
C. spp.		40
Claytonia lanccolata	5	95
Collinsia parviflora	25	50
Collomia lincaris	35	
Epilobium angustifolium	25	
E. spp.	45	75
Erythronium grandiflorum	35	
Festuca idahoensis		25
Fragaria virginiana	10	20
Gaillardia aristida	5	
Lewisii pygmea		5
Linnanthus septentrionalis		65
Lupinus argentus	10	
Melica spectabilas		80
Osmorhiza occidentale	5	
Phleum alpinum		40
Poa alpina		15
P. nervosa	5	20
Polygonum douglasii	5	80
Potentilla diversifolia		95
Senecio integerrimus		100
Stipa occidentalis	5	75
Taraxicum laevigatum	45	75
T. officinale	10	
Trifolium longipes		10
Vaccinium scoparium	30	
Valeriana sitchensis	5	
Viola nuttallii	35	65

FOREST COMMUNITIES

On the basis of the two models presented in this report, any specific location in the Long Tom study area can be described in terms of tree basal area and habitat type if altitude and aspect of a classified photo-point are known. The major obvious drawback to this system as applied in Long Tom Creek is that considerable care must be taken in distinguishing the B2EF type and recognizing that the apparent shrub understory is actually small trees in virtually all locations.

Submitted By: L. Jack Lyon

JOB II-B

LONG TOM CREEK STUDY

PROGRESS REPORT FOR THE PERIOD
January 1, 1973-December 31, 1973

INTRODUCTION

The objectives of this study are to determine the environmental requirements of elk and the impact of logging on an elk population in the scattered forest type of Long Tom Creek in Southwestern Montana.

Field work was conducted from June-November each year, 1971-1973. Fourteen clearcuts ranging from 17 to 106 acres and averaging 44.3 acres in size are planned for the area (Fig. 1). Also scheduled is 3.9 miles of road reconstruction and 9.5 miles of new road construction. The road reconstruction has been completed and approximately 3.5 miles of new road construction was partially completed during the fall of 1973. Present plans are to complete the new road construction and begin logging by the fall of 1974.

DESCRIPTION OF THE STUDY AREA

Long Tom Creek, located about 25 miles southwest of Butte, Montana is a side drainage of Jerry Creek which flows southerly and empties into the Big Hole River near the village of Wise River (Fig. 2). Elevations range from 7,000 to 9,100 feet with the Continental Divide forming the north boundary of the study area. The Long Tom Creek-Upper Johnson Creek study area comprises about 36 square miles and is mostly timbered. A variety of cover types are represented, including lodgepole pine, Douglas-fir, subalpine fir, whitebark pine, spruce, and combinations thereof. The area is interspersed with numerous small, wet sedge meadows and bogs, parks, rocky ridges and open, south-facing sagebrush and grass-covered slopes. Clearcut logging has occurred in the head of Jerry Creek to the east and in Lower Johnson Creek to the south and southwest. The only vehicle access to the area is by 4-wheel drive from the east and northeast during periods of relatively dry road conditions. The study area is a portion of Hunting Unit 319.

METHODS

As in 1972, summer and fall elk distribution was determined in 1973 primarily from "elk sign" observed while periodically and systematically walking approximately 62 miles of foot routes. Eight of the 11 established foot routes were walked 7 times each and the other 3 were walked 6 times each. The time interval between each "run" was approximately 3 weeks. During 1972, each route was walked 4 times each (August 1 - November 9).

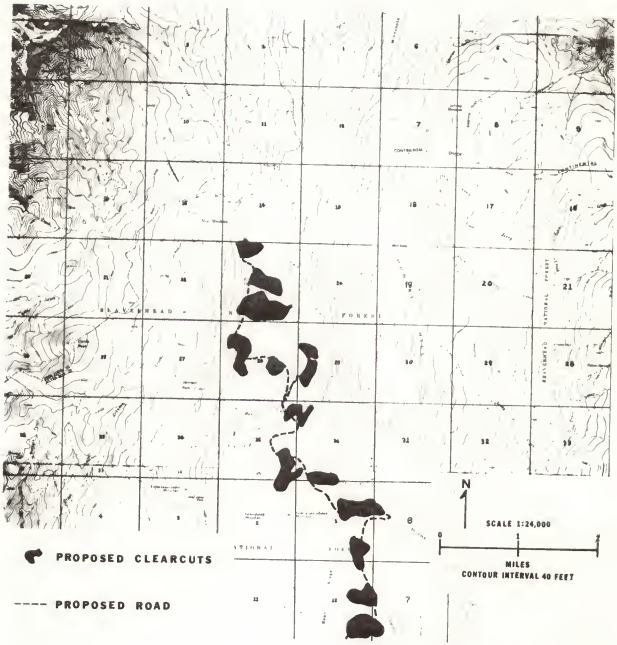


Figure 1. Proposed clearcuts and main road construction.

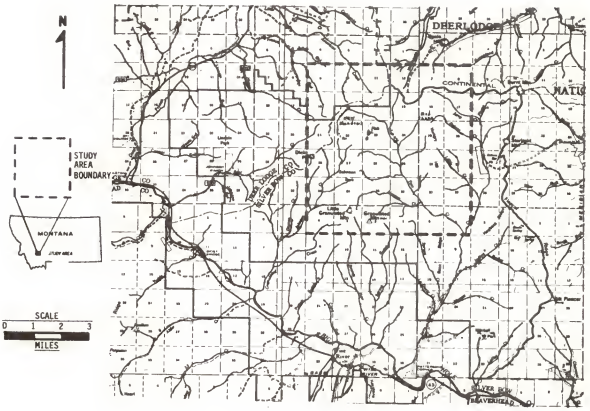


Figure 2. Vicinity of Long Tom Creek Study Area.

In 1973, comparatively mild winter and spring weather conditions allowed us to begin walking routes on June 5, while comparatively severe weather conditons prevented any routes to be walked after October 31. Minor revisions of the segment classification system for the foot routes were made. For further detail and description of the segment classification system, see last year's progress report (Lonner and Allen, 1973). In 1973, each of the 700 segments was paced and other measurements made on a periodic or one-time basis (Tables 1 and 2). These measurements will provide the opportunity to quantitatively compare intensity of elk use (pellet groups/pace) between segments with various environmental characteristics and will also provide a relatively sensitive method of describing not only seasonal shifts in elk distribution, but yearly shifts as well.

The 14 sub-divisions made of the study area in 1972 have been revised into 16 sub-divisions. Each of the 16 areas includes a portion of the foot route system (Fig. 3). The proportion of each sub-divided area within the study area and the proportion of general cover types within each area are presented in Table 3.

Radio telemetry was again used in an attempt to gather detailed data on elk movements and distribution in and between the study area and the Fleecer winter game range. Nine elk were radioequipped during the months of April and May, 1973. All transmitters were put on using a helicopter and capture gun. All radios ceased functioning by August 27 in or adjacent to the study area and by mid-August outside the study area.

Hunter check station questionnaires were filled out on opening day of the general big game season at 5 check stations located near the Long Tom Creek study area. A small number of questionnaires (10) were filled out on November 17, 1973 near one of these 5 check stations. An attempt to use questionnaires at these 5 locations, at least during opening day of the general big game hunting season, will be made for each of the successive years of the study. This should provide us with a trend index on hunting pressure, elk harvest, and elk seen per hunter within and adjacent to the study area.

Time lapse photography was introduced into the study last year and proved to be a very worthwhile tool in quantitatively and objectively measuring elk use of specific areas (natural and artificial openings) in the study area. The camera was rigged to take pictures during daylight hours at an interval of 5 minutes (approximately 150-180 frames a day depending on light conditions in the morning and evening). Three more cameras are planned to be used during the 1974 field season.

Most data collected thus far has been transposed onto data processing cards for computer analysis.

FINDINGS

Elk Use and Distribution

The study area is used primarily as elk summer and fall range, generally

Table 1. List of 28 measurements for each of the 700 segments composing the 62 mile foot route system in the Long Tom Creek study area.

Elk use (pellet groups categorized into last year, this year, recent, and fresh; and general impression of elk use)[1]
Deer use (pellet groups, observations, tracks)[1]
Cattle use (droppings per pace, observations, tracks)[1]
Forage use[1]
Wetness type[1]
Wetness degree[1]
Segment length[2]
Cover type[2]
Habitat type
Dominant and sub-dominant tree species
Average tree height
Density of mature trees
Density of regeneration
dbh averages
Canopy coverage
Tree age sample
Distance to next closest cover type
Sight distance[2]
Downfall[2]
Ground cover or understory vegetation
Aspect[3]
Configuration[3]
Topography[3]
Slope (%)[3]
Size of opening (park, broken park, clearcut)segment passes thru (if applicable)
Indices of interspersion, diversity, and homogeneity for each of the 4 general cover types and combinations thereof.[4]

[1]Measured each time segment is surveyed (all others only measured once).
[2]Measurements are completed.
[3]Measurements are approximately 75 percent completed.
[4]Measurements will be made as explained in last years progress report.

Table 2. Number of segments, their length and percent of total length; listed by general cover types with 2 wetness categories.

Cover Type	Number of Segments			Mean Length (paces)			Total (paces)			Miles[1] (approx.)			Percent of Total length		
	All Segs.	Wet Segs.	Wet Segs. ≥ 50%	All Segs.	Wet Segs.	Wet Segs. ≥ 50%	All Segs.	Wet Segs.	Wet Segs. ≥ 50%	All Segs.	Wet Segs.	Wet Segs. ≥ 50%	All Segs.	Wet Segs.	Wet Segs. ≥ 50%
Clearcut	13	5	0	206.8	235.4	0	2,688	1,177	0	1.5	.7	0	2.5	1.1	0
Timber	307	48	0	181.3	152.6	0	55,966	7,325	0	31.8	4.2	0	51	6.7	0
Broken Park	190	81	39	125.5	183.1	93.9	23,720	11,485	3,661	13.5	6.5	2.1	21.5	10.5	3.3
Park	190	102	24	143.8	112.6	117	27,466	14,831	2,806	15.6	8.4	1.6	25	13.5	2.6
TOTAL	700	236	63	156.6	147.6	102.7	109,840	34,818	6,467	62.4	19.8	3.7	100	32	5.9

[1]Approximately 1,760 paces per mile.

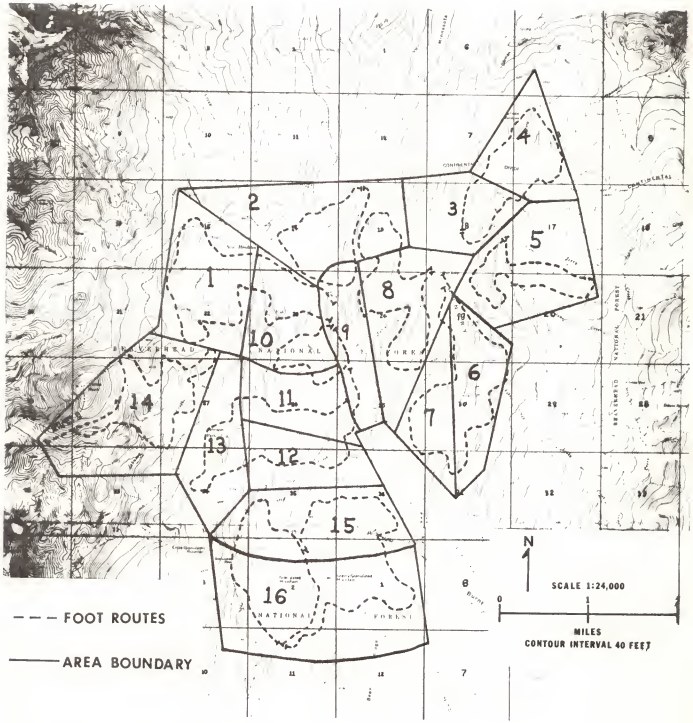


Figure 3. Subdivided areas and established foot routes.

Table 3. Proportion of the general cover types within each subdivided area and proportion of each area within the study area.

Sub-divided Areas	General Cover Type				
	Park	Broken Park	Timber	Clearcut	Total
1	2,311/28[1]	2,246/27	3,705/45	0	8,262/8[2]
2	1,592/20	2,646/34	3,536/46	0	7,774/7
3	1,449/28	1,637/32	2,092/40	0	5,178/5
4	278/7	1,464/36	2,366/57	0	4,108/4
5	1,446/18	848/11	2,969/37	2,688/34	7,951/7
6	844/16	941/19	3,375/65	0	5,160/5
7	454/9	1,082/22	3,348/69	0	4,884/4
8	3,463/34	2,350/23	4,452/43	0	10,265/9
9	2,236/34	716/11	3,542/55	0	6,494/6
10	1,934/24	909/11	5,249/65	0	8,092/7
11	822/17	2,207/46	1,782/37	0	4,811/4
12	1,288/35	649/18	1,737/47	0	3,674/3
13	1,031/20	1,534/30	2,576/50	0	5,141/5
14	3,078/27	2,212/19	6,095/54	0	11,385/10
15	1,802/19	1,608/18	5,719/63	0	9,129/8
16	3,438/46	671/9	3,423/45	0	7,532/7
Total	27,466/25	23,720/21.5	55,966/51	2,688/2.5	109,840/100

[1]Actual number of paces/percent of total paces in area.
[2]Actual number of paces/percent of total paces in route system.

between June 10 and mid-November dependent upon snow conditions. Elk use of the study area was evaluated on a seasonal basis from June through August (summer season), September through early October (rutting season), and early October through late October - early November (first third of hunting season) for both the 1972 and 1973 field seasons. Twenty-five percent of the route system was park, 21.5 percent broken park, 51 percent timber, and 2.5 percent clearcut (Table 2).

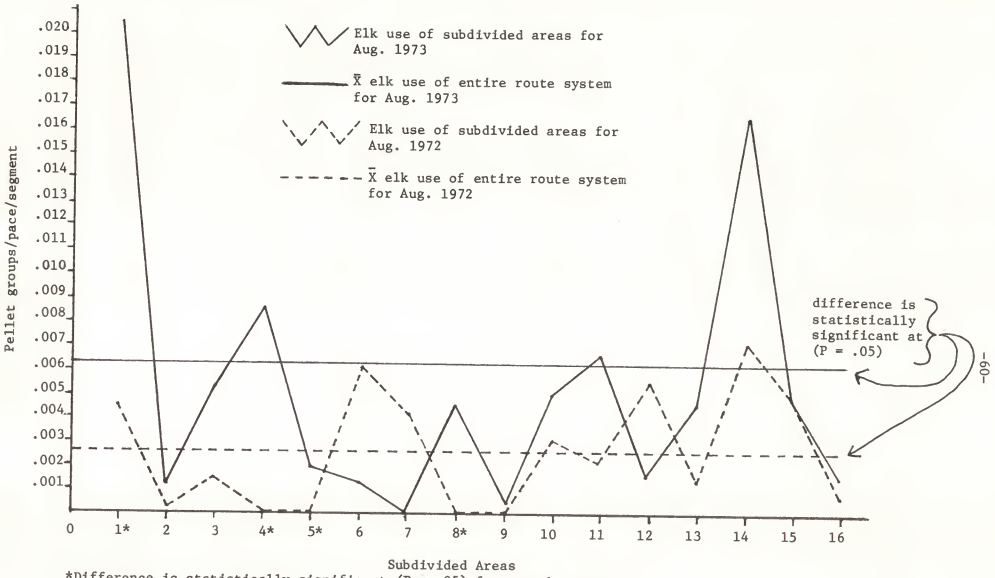
There is limited data on elk use during the summer season of 1972, since the first time the route system was walked during that year was in August. Elk use of the study area appeared to be greater in August 1973 than in August 1972, since mean elk use (pellet groups/pace/segment) in 1973 was .0063 and in 1972 it was .0026 (Fig. 4). Mean elk use of the study area from September-early October and in early November during 1972 appeared to be greater than for similar time periods in 1973 (Figs. 5 and 6). The difference of the mean elk use for each one of these 3 time periods between 1972 and 1973 was statistically significant (P=.05). Results from check station questionnaires completed on opening day (10/21) of the general big game season in 1973 also indicated the density of elk in the study area to be comparatively low during this time period. Elk seen per hunter and elk seen per hunter hour walked was .27 and .16, respectively, in the study area, while for the surrounding adjacent area these figures were .73 and .42, respectively.

The broken park general cover type seemed to be the most preferred cover type used by elk during the summer of 1973, since 38 percent of the summer elk use (pellet groups/pace) occurred in this type (Fig. 7). Park also seemed to be preferred with 32 percent of the summer elk use occurring in this type, while elk use in the clearcut type was proportionate at 2 percent and inversely proportionate (not as preferred) in the timber cover type at 28 percent.

Although elk use of the general cover types in August of 1972 shows this same tendency (with exception of the clearcut type), it is not as pronounced and is probably more representative of elk use of the cover types approaching the rutting season than for the summer season in general (Fig. 8).

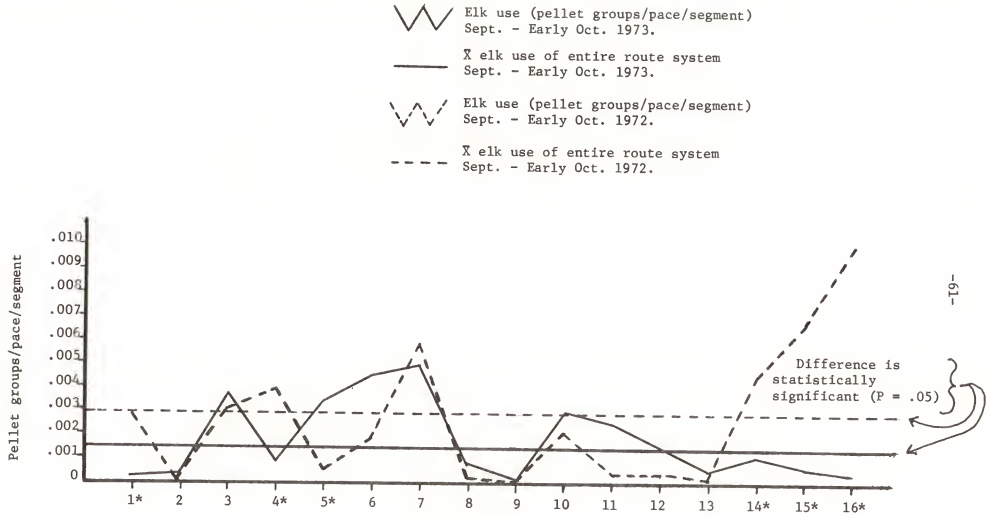
During the rutting season in 1973, elk use of the park and broken park cover types appeared to be nearly proportionate to their occurrence, while for this same period in 1972 elk use appeared to be higher in the park and lower in the broken park type. For the timber type elk use in 1973 was 57 percent and 55 percent in 1972, indicating it was a preferred type for both years during this season. Elk use of the clearcut type for this season was about proportionate for both years.

"General impression of elk use", as explained in last year's progress report, (Lonner and Allen, 1973) during the early portion of the hunting season was nearly proportionate for all cover types, except use was higher for the broken park cover type in 1972 and the clearcut cover type in 1973.



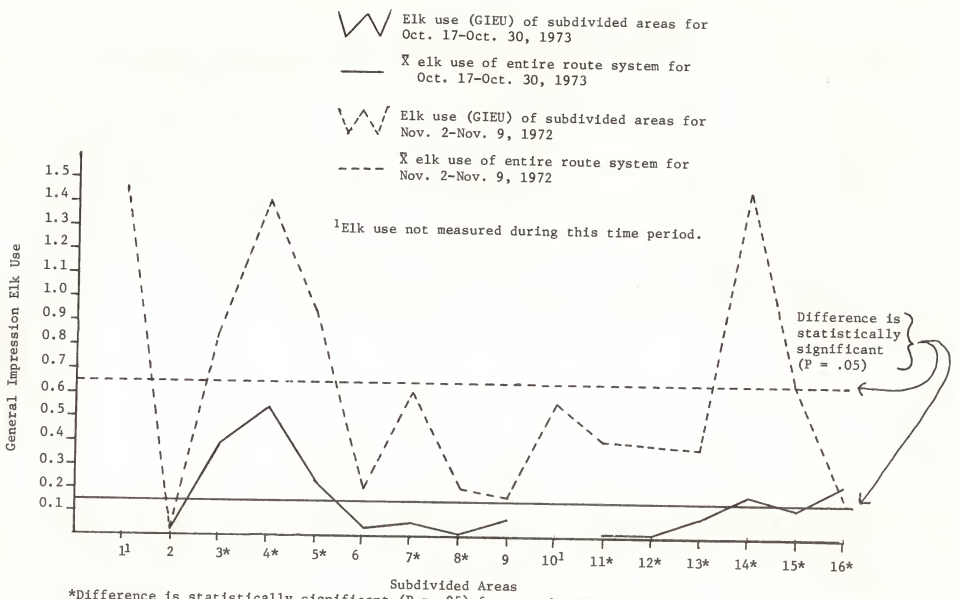
*Difference is statistically significant (P = .05) for area between years.

Figure 4. Comparison of the average elk use (pellet groups/pace/segment) between the 16 subdivided areas and for the entire route system between August 1972 and 1973.


Elk use (pellet groups/pace/segment) Sept. - Early Oct. 1973.
X elk use of entire route system Sept. - Early Oct. 1973.
Elk use (pellet groups/pace/segment) Sept. - Early Oct. 1972.
X elk use of entire route system Sept. - Early Oct. 1972.
Pellet groups/pace/segment
.010
.009
.008
.007
.006
.005
.004
.003
.002
.001
0
Difference is statistically significant (P = .05)
1* 2 3 4* 5* 6 7 8 9 10 11 12 13 14* 15* 16*
Subdivided Areas

*Difference is statistically significant (P = .05) for area between years.

Figure 5. Comparison of the average elk use (pellet groups/pace/segment) between the 16 subdivided areas and for the entire route system between Sept.-early Oct. 1972 and 1973.


Elk use (GIEU) of subdivided areas for Oct. 17-Oct. 30, 1973
$\bar{X}$ elk use of entire route system for Oct. 17-Oct. 30, 1973
Elk use (GIEU) of subdivided areas for Nov. 2-Nov. 9, 1972
$\bar{X}$ elk use of entire route system for Nov. 2-Nov. 9, 1972
[1]Elk use not measured during this time period.
Difference is statistically significant (P = .05)
General Impression Elk Use
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1[1] 2 3* 4* 5* 6 7* 8* 9 10[1] 11* 12* 13* 14* 15* 16*
Subdivided Areas

*Difference is statistically significant (P = .05) for area between years.

Figure 6. Comparison of the average elk use (general impression elk use (GIEU) between the 16 subdivided areas and for the entire route system between Oct. 17-Oct. 30, 1973, and Nov. 2-Nov. 9, 1972.

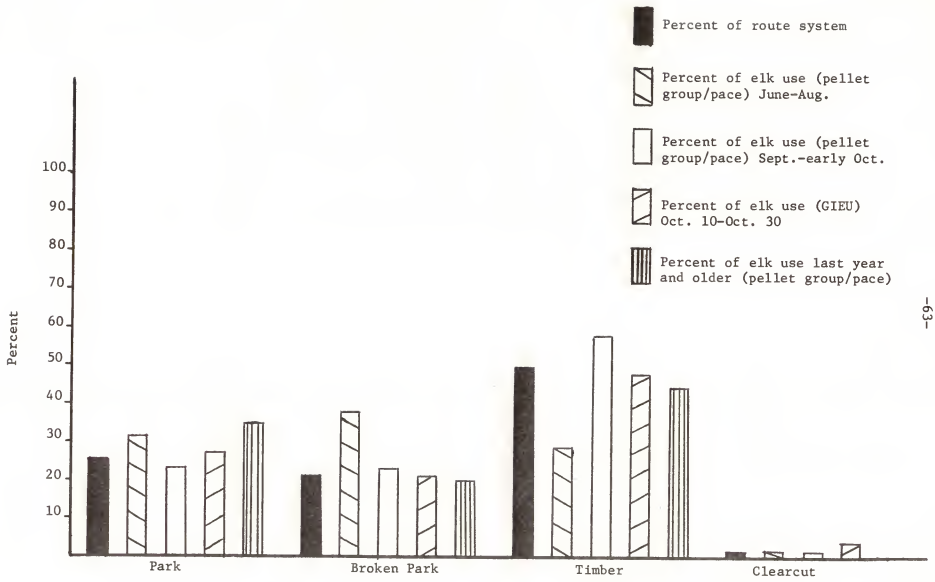


Figure 7. Comparison of elk use (percent pellet groups/pace) within and between 4 general cover types during June-Aug., Sept.-early Oct., and mid to late Oct., 1973.

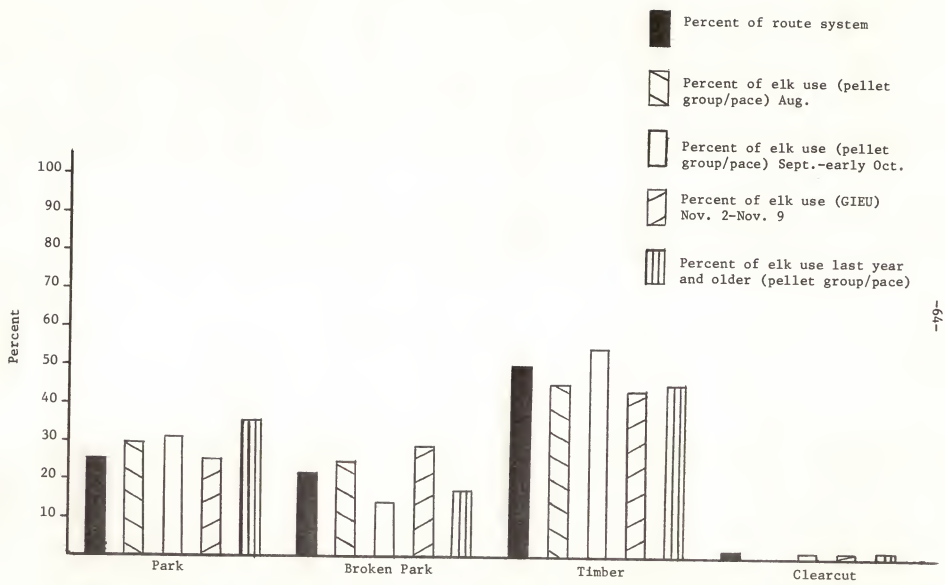


Figure 8. Comparison of elk use (percent pellet groups/pace) within and between 4 general cover types during Aug., Sept.-early Oct., and early Nov., 1972.

Elk use of the study area and of the various cover types was also evaluated for the previous fall (s) approximately (Sept. 1 - Nov. 30) by recording old pellet groups during the first "run" of all routes each field season. Data collected in 1973 and 1972 for both 1972 and 1971, old pellet groups/pace showed fall elk use to be highest in park (35 percent) and timber (45 percent) cover types. In 1973 there wasn't any "old" elk use recorded in the clearcut type (Figs. 7 and 8).

Influence of Wetness type and Degree

A major influencing factor on elk use and distribution in the study area during the summer season appeared to be wetness conditions. Wetness type and degree was only measured in September during 1972. During June-August in 1973 an average of 68 percent of the route system was dry and accounted for 50 percent of the elk use (pellet groups/pace) during this time period. The other 50 percent of the elk use occurred in that portion of the route system (32 percent) that was classified as wet (Fig. 9). Over one-fourth (27 percent) of the total elk use during this season occurred in those segments classified as wet broken parks, which composed only one-tenth of the route system (Table 4). Nearly 10 percent of the elk use occurred in those segments classified as very wet (≤ 50% wetness) broken parks. This classification involved only 3.3 percent of the route system. Eighty-two percent of the elk use in that portion of the route system classified as wet occurred in those segments classified as marsh,standing water-marsh, and running water-marsh. These classifications made up almost 73 percent of the wet segments. The most intense elk use occurred in those segments with a wetness type of standing water-marsh with a wetness degree of from 50-90 percent and in those segments with a wetness type of standing water-marsh-bog with wetness degrees of 26-50 percent and 91-100 percent, (Table 5). The ground cover composition of these wet areas is largely made up of Carex, spp. (*C. scopulorum, C. microptera, C. luzulina, C. illota, C. aqualatic, C. rostrata,* and Carex spp. Ovales group), *Senecio triangularis, Senecio intergerimis, Arnica mollis, Phleum alpinum, Deschampsia Caespitosa, Veratrum viride,* and *Calamagrostis canadensis.*

During September of both 1972 and 1973 elk use of the dry segments was 71 and 86 percent, respectively, while this type composed 68 percent of the route system in 1972 and 73 percent of the route system in 1973 during this time period. Elk use of those segments with wetness degrees of 1 - 25 percent and 76 - 100 percent was inversely proportionate to their availability for both 1972 and 1973. The elk use that occurred in that portion of the route system with a wetness degree of from 26 - 75 percent was proportionately greater than the occurrence of this wetness category for both 1972 and 1973 (Fig. 10). There was a large variation in proportions of wetness types during this time period between 1972 and 1973 (Tables 6 and 7). This variation can be largely attributed to climatic conditions, since the summer and early fall of 1973 was comparatively drier than that of 1972. During September in 1972, 34 percent of the elk use in that portion of the route system classified as wet occurred in three wetness types (standing water-running water-marsh, standing water-marsh-bog, standing water-running water-marsh-bog). These three wetness types composed almost 12 percent of the wet segments during that year. In 1973 these 3 types composed 4.4 percent of the wet

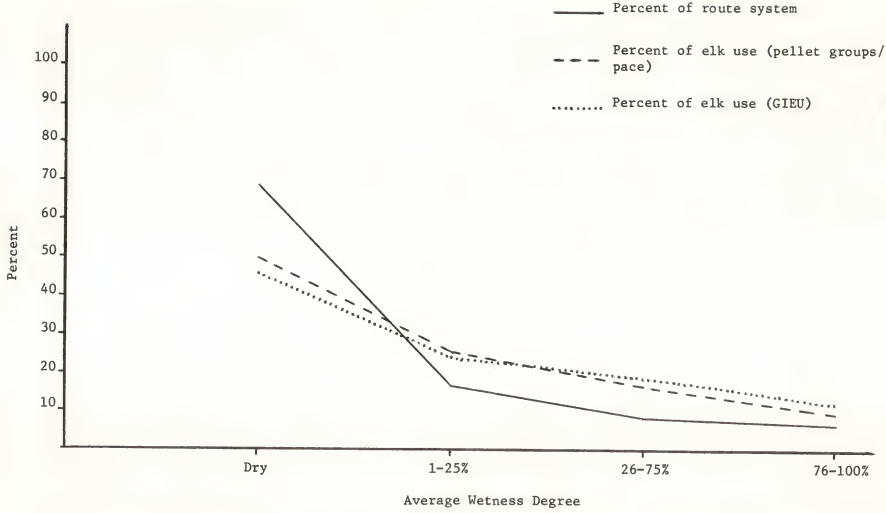


Figure 9. Elk use (percent) of the study area related to wetness degree categories for June-August, 1973.

Table 4. General relationships of elk use (pellet groups/pace) with general cover types and wetness degree for the period June-August 1973.

Cover Type	All segments of all routes			All wet segments of all routes			All wet segments ≥ 50% of all routes		
	Percent of Total Area	$\bar{X}$ Wetness Degree (%)	Percent of Total Elk Use	Percent of Total Area	$\bar{X}$ Wetness Degree (%)	Percent of Total Elk Use	Percent of Total Area	$\bar{X}$ Wetness Degree (%)	Percent of Total Elk Use
Park	25	11	32	13.6	55	15	2.6	71	4
Broken Park	21.5	21	38	10.5	60	27	3.3	71	9
Timber	51	1	28	6.7	23	7	0	0	0
Clearcut	2.5	3	2	1.1	32	.6	0	0	0
TOTAL	100	9	100	32	47	50	6	71	13

Table 5. Comparisons of elk use within and between various wetness type combinations and degrees for June-August, 1973.

Wetness Type[1]	Wetness Degree (%)						
	0 - 5	6-25	26-50	51-75	76-90	91-100	Total
SW	.8/1/.0027[2]*	.1/0/0	.1/0/0	.5/0/0	0/0/0	0/0/0	1.5/1/.0017
RW	15/14/.0021	.5/0/0	0/0/0	0/0/0	.2/0/0	0/0/0	15.7/14/.0019
M	12/11/.0025*	6/0/0	5/10/.0036*	4/4/.0022*	4/4/.0013	18/0/0	31.8/38/.0024*
B				NONE CLASSIFIED			
SW,RW	0/0/0	0/0/0	.1/0/0	0/0/0	0/0/0	0/0/0	.1/0/0
SW,M	.8/T/.0019	1/T/.003*	2/1/.0019	.6/2/.0056*	1/5/.0086*	.4/0/0	5.8/8/.0039*
SW,B				NONE CLASSIFIED			
RW,M	7/3/.0012	10/10/.0029*	6/12/.0039*	4/6/.003*	6/4/.0015	1/T/.0005	35/36/.0025*
RW,B				NONE CLASSIFIED			
M,B	.1 /0/0	.3/0/0	.2/0/0	.3/0/0	.4/0/0	.7/0/0	2/0/0
SW,RW,M	0/0/0	.3/0/0	.1/0/0	.1/0/0	1/0/0	.2/0/0	1.7/0/0
SW,RW,B				NONE CLASSIFIED			
SW,M,B	0/0/0	0/0/0	.2/1/.0018	0/0/0	.2/0/0	.1/T/.0053*	.5/1/.0056*
RW,M,B	0/0/0	.3/0/0	.2/0/0	1/0/0	2/1/.0009	2/1/.0007	5.5/2/.0006
SW,RW,M, B	0/0/0	0/0/0	0/0/0	0/0/0	.3/0/0	T/0/0	.4/0/0

[1]SW = standing water, RW = running water, M = Marsh, B = bog.

[2]Percent of total route system classified wet composed of this wetness type and degree/Percent of total elk use (pellet groups/pace) that occurred in route system classified wet/Intensity of elk use (pellet groups per pace per segment) that occurred in particular wetness type and degree category.

*Indicates elk use intensity was above the mean intensity of .00219, which was computed from the total elk use during this time period for that portion of the route system classified wet.

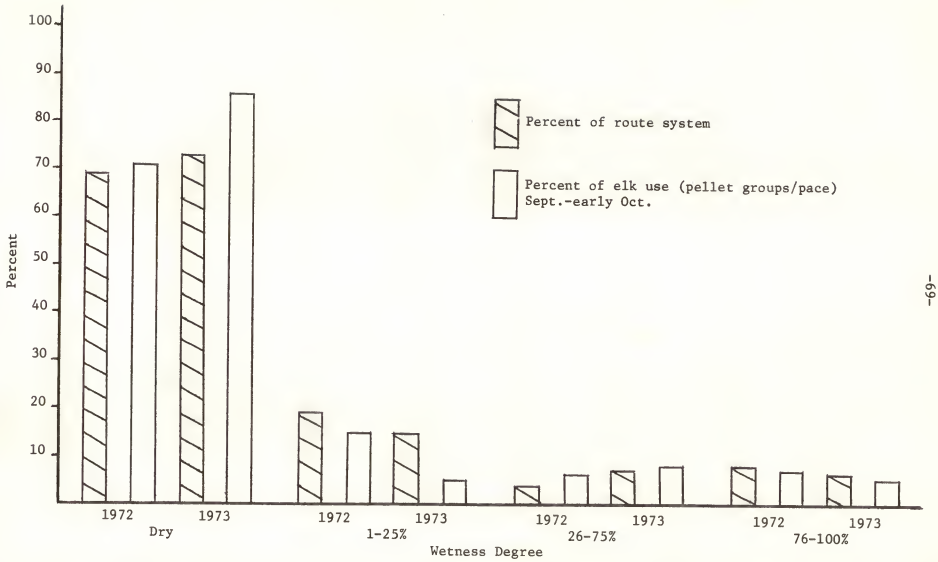


Figure 10. Comparison of elk use (percent pellet groups/pace) during Sept.-early Oct. within and between 1972 and 1973 as related to wetness degree categories.

Table 6. Comparisons of elk use within and between various wetness type combinations and degrees for September, 1972.

Wetness Type[1]	Wetness Degree (%) 0 - 5	6-25	26-50	51-75	76-90	91-100	Total
SW	1/0/0[2]	0/0/0	0/0/0	0/0/0	.7/0/0	0/0/0	1.7/0/0
RW	15/10/.0015	.6/0/0	0/0/0	0/0/0	0/0/0	0/0/0	15.6/10/.0014
M	11/2/.0023	.6/18/.0047*	2/0/0	.6/0/0	2/2/.0011	.1/0/0	16.3/22/.0026
B	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	.2/0/0	.2/0/0
SW,RW	1.4/0/0	1/0/0	0/0/0	0/0/0	1.3/0/0	0/0/0	3.7/0/0
SW,M	.5/0/0	1.5/1/.0017	.1/5/.026*	1/0/0	.6/0/0	.4/1/.0079*	4.1/7/.0037*
SW,B			NONE CLASSIFIED				
RW,M	6/4/.002	7/3/.0008	4/0/0	2/7/.006*	3/5/.003	1/0/0	23/19/.0018
RW,B			NONE CLASSIFIED				
M,B	.5/0/0	.6/4/.011*	2/T/.001	1/0/0	2/1/.0017	1/0/0	7.1/5/.0014
SW,RW,M	0/0/0	.6/1/.004*	.7/0/0	1/9/.018*	.7/5/.014*	1/0/0	4/15/.0081*
SW,RW,B			NONE CLASSIFIED				
SW,M,B	2/0/0	0/0/0	0/0/0	.1/4/.019*	6/4/.01*	1/2/.006*	3.7/10/.0088*
RW,M,B	0/0/0	2.4/1/.0025	0/0/0	.2/0/0	10/2/.0015	2/0/0	14.6/3/.0011
SW,RW,M,B	0/0/0	1/0/0	0/0/0	0/0/0	1/0/0	2/9/.01*	4/9/.0074*

[1]SW = standing water, RW = running water, M = marsh, B = bog.

[2]Percent of total route system classified wet composed of this wetness type and degree/Percent of total elk use (pellet groups/pace) that occurred in route system classified wet/Intensity of elk use (pellet groups per pace per segment) that occurred in particular wetness type and degree category.

*Indicates elk use intensity was above the mean intensity of .0033, which was computed from the total elk use during this time period for that portion of the route system classified wet.

Table 7. Comparisons of elk use within and between various wetness type combinations and degrees for September, 1973.

Wetness Type[1]	Wetness Degree (%)						
	0 - 5	6-25	26-50	51-75	76-90	91-100	Total
SW	.1/0/0[2]	.7/0/0	0/0/0	0/0/0	0/0/0	0/0/0	.8/0/0
RW	15/0/0	.7/0/0	0/0/0	.6/0/0	0/0/0	0/0/0	16.3/0/0
M	11/8/.001*	7/13/.0014*	5/6/.001*	5/14/.0018*	6/20/.0025*	3/4/.0007	37/43/.0015*
B				NONE CLASSIFIED			
SW,RW				NONE CLASSIFIED			
SW,M	0/0/0	1/0/0	2/0/0	1/0/0	1/16/.012*	0/0/0	5/31/.0043*
SW,B				NONE CLASSIFIED			
RW, M	5/4/.0008	12/13/.0017*	4/0/0	7/3/.0004	6/0/0	.5/0/0	34.5/26/.0006
RW,B				NONE CLASSIFIED			
M,B	0/0/0	0/0/0	0/0/0	1/0/0	.2/0/0	0/0/0	1.2/0/0
SW,RW,M	2/0/0	0/0/0	1/0/0	.4/0/0	1/0/0	0/0/0	4.4/0/0
SW,RW,B				NONE CLASSIFIED			
SW,M,B				NONE CLASSIFIED			
RW,M,B	0/0/0	0/0/0	0/0/0	0/0/0	.2/0/0	0/0/0	.2/0/0
SW,RW,M,B				NONE CLASSIFIED			

[1]SW = standing water, RW = running water, M - marsh, B - bog.

[2]Percent of total route system classified wet composed of this wetness type and degree/Percent of total elk use (pellet groups/pace) that occurred in route system classified wet/Intensity of elk use (pellet groups per pace per segment) that occurred in particular wetness type and degree category.

*Indicates elk use intensity was above the mean intensity of .0008, which was computed from the total elk use during this time period for that portion of the route system classified wet.

segments and accounted for none of the elk use during this time period. Most of the elk use (74 percent) during September in 1973 occurred in the marsh and standing water-marsh types, which made up 42 percent of the wet segments during this year. For both 1972 and 1973 the most intense elk use occurred in the standing water-marsh wet type, with wetness degrees of 26 - 50 percent in 1972 and 76 - 90 percent in 1973 (Tables 6 and 7).

Characteristics of Bedding Sites

Measurements of various physical characteristics associated with 124 elk bedding sites (a bedding site may range from 1 to any number of individual elk beds) in the Long Tom Creek study area during the summer and early fall of 1972 and 1973 also indicated a strong affinity for wetness. Seventy-nine percent of the bed sites were located in wet conditions with 56 percent located in wetness type marsh-bog-standing water or combinations thereof (Table 8). Fifty-five percent of the bed sites found were in situations with a wetness degree ranging from 50 - 100 percent. Other characteristics describing these bedding site locations were (the number after each stated characteristic is the percent of bed site locations with this characteristic): general cover type was either park (40 percent) or broken park (51 percent); dominant tree species was usually Engelmann spruce (82 percent); degree of downfall was none to light (99 percent); sight distance ranged from 75-200 feet (54 percent); dominant tree species average height was greater than 40 feet (62 percent); and distance to next closest general cover type ranged from 10-100 feet (83 percent) (Table 8).

Elk distribution

The distribution of elk use throughout the study area as defined by the 16 subdivided areas was positively correlated with average wetness degree of these areas during the second, third, and fourth "runs" of the route system during 1973 (Fig. 11). This correlation was statistically significant ($P=.05$) for the second ($r=.67$) and third ($r=.62$) runs. Elk use of the study area measured in August of 1973 was distributed similarly to the elk use of the study area measured in August, 1972 with exception of subdivided areas 1, 4, 5, 8, and 11 (Fig. 4). These 5 areas had significantly ($P=.05$) more elk use in 1973 than in 1972. The mean elk use (pellet groups/pace/segment and "general impression of elk use") of the study area did not differ between the 2nd, 3rd, and 4th "runs" of the route system in 1973. The elk use was significantly higher $P=.05$) between each of these runs and the first run (Figs. 12 and 13). Apparently elk were just starting to get into the study area in June during the first run.

Although the mean elk use didn't change within the study area between the 2nd, 3rd, and 4th runs in 1973, shifts of elk use did occur between runs and subdivided areas as described by the 2 methods of elk use measurement. Illustrations of these shifts are presented in Figures 12 and 13. Elk use within subdivided areas 5, 10, 14, and 15 was most consistently above the mean elk use for each of these areas during the 2nd, 3rd, and 4th runs in 1973 resulting from the pellet groups/pace/segment elk use

Table 8. Percentages of 124 elk bedding sites as related to various physical characteristics; measured in the Long Tom Creek Study Area during Summer and Fall, 1972-73.

GENERAL[1] COVER TYPE				GROUND COVER[2]		WETNESS TYPE[3]				WETMESS DEGREE	
P	BP	T	CC	CAR. Spp., SETR LEGL, PHAL	OTHER	RW, M, B, SW	M, B, SW	ALL WET TYPES	DRY	0-50%	50%-100%
40	51	7	2	88	12	23	56	79	21	45	55

DOMINANT TREE SPECIES[4]					DOWNFALL[5]				SIGHT DISTANCE		
PIEN	ABLA	PIAL	PICO	PSME	N	L	M	H	0-75'	75'-200'	200+
82	3	10	4	1	55	44	1	0	44	54	2

DOMINANT TREE SPECIES AVERAGE HEIGHT					DISTANCE TO NEXT CLOSEST GENERAL COVER TYPE					
0-10'	10'-30'	30'-40'	40'-60'	60'+	0-10'	10'-25'	25'-50'	50'-100'	100'-200'	200'+
6	14	18	45	17	7	24	35	24	7	3

[1]P=park, BP=broken park, T=timber, CC=clearcut.
[2]CAR=Carexes; SETR=*Senecio triangularis;* LEGL=*Ledum glandulosum;* PHAL=*Phleum alpinum L.*
[3]RW=running water, M=marsh, B=bog, SW=standing water.
[4]PIEN=Engelmann spruce, ABLA=Alpine Fir, PIAL=Whitebark Pine, PICO=Lodgepole Pine, PSME=Douglas-Fir.
[5]N-none, L=light, M=moderate, H=heavy.

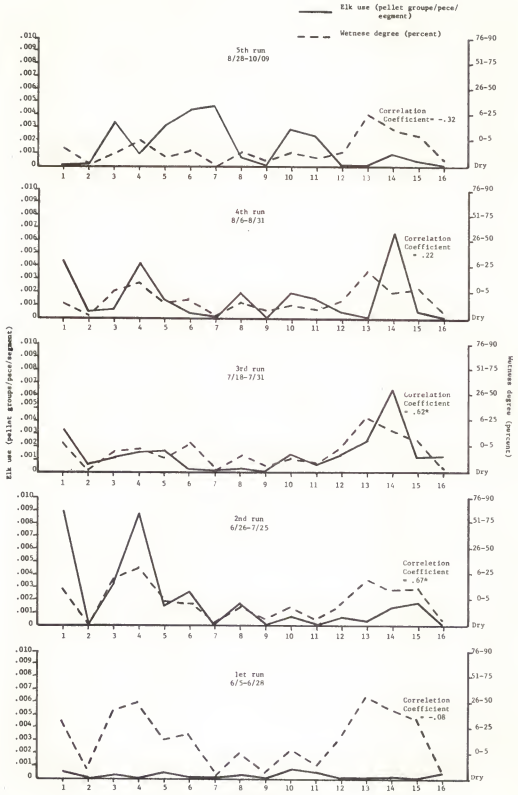


Figure 11. Distribution and correlation of elk use (pellet groups/pace/segment) and wetness degree as defined by the 16 subdivided areas during the first 5 "runs" of the route system in 1973.

[1]2nd, 3rd, and 4th run averages were significantly higher (P=.05) than the 1st run average. There was no significant difference between the 2nd, 3rd, and 4th run averages.

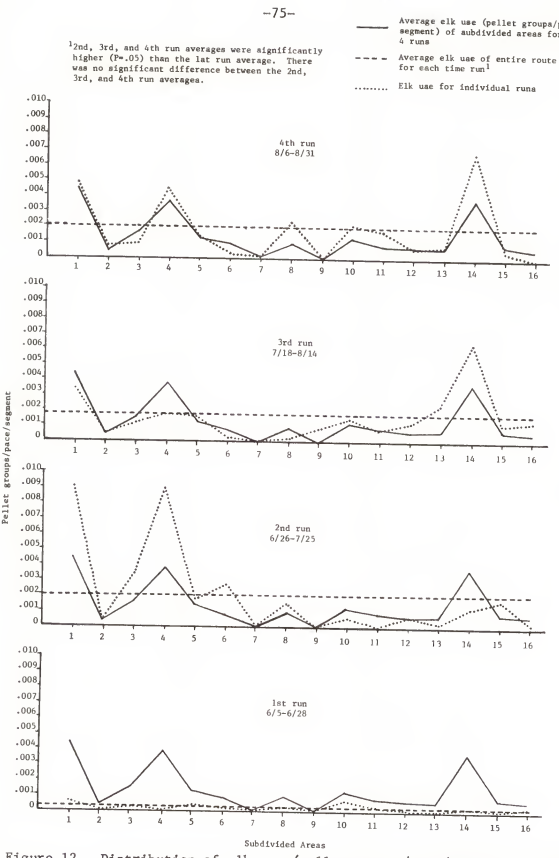

Average elk use (pellet groups/pace/segment) of subdivided areas for all 4 runs
Average elk use of entire route system for each time run[1]
Elk use for individual runs
4th run 8/6-8/31
3rd run 7/18-8/14
2nd run 6/26-7/25
1st run 6/5-6/28
Pellet groups/pace/segment
Subdivided Areas

Figure 12. Distribution of elk use (pellet groups/pace/segment) among the 16 subdivided areas and its relation to the average elk use for each area and the average elk use of the entire route system for each time "run" during June-August 1973.

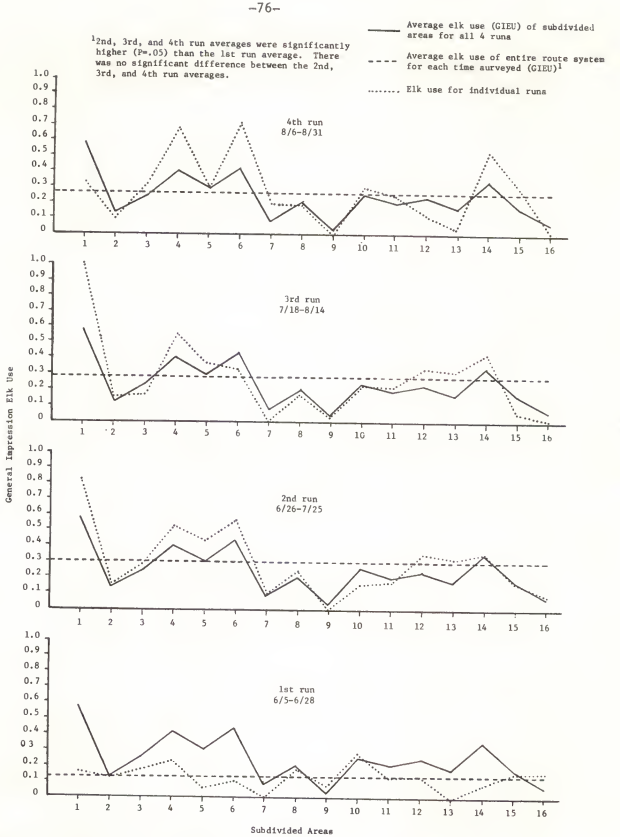

[1]2nd, 3rd, and 4th run averages were significantly higher (P=.05) than the 1st run average. There was no significant difference between the 2nd, 3rd, and 4th run averages.
Average elk use (GIEU) of subdivided areas for all 4 runs
Average elk use of entire route system for each time surveyed (GIEU)[1]
Elk use for individual runs
4th run 8/6-8/31
3rd run 7/18-8/14
2nd run 6/26-7/25
1st run 6/5-6/28
General Impression Elk Use
Subdivided Areas

Figure 13. Distribution of elk use (general impression-GIEU) among the 16 subdivided areas and its relation to the average elk use for each area and the average elk use of the entire route system for each time "run" during June-August 1973.

method and in areas 1, 2, 4, 5, 11, 12, 13, and 14 using the "general impression of elk" use method. Elk use within areas 1, 4, and 14 was most consistently above the mean elk use of the entire study area for the 2nd, 3rd, and 4th runs using the pellet groups/pace/segment elk use method and in areas 1, 4, 5, 6, 12, 13, and 14 using the "general impression of elk" use method. These two methods of measuring elk use in the study area between years and within years should be evaluated separately since the criteria for measuring elk use using the general impression method is much broader than the criteria for measuring elk use using the pellet groups/pace/segment method.

Elk use of the study area measured in Sept.-early Oct. 1973 was distributed similarly to the elk use in 9 of the 16 subdivided areas measured during this same time period in 1972 (Fig. 5). Both the pellet group/pace/segment method and the "general impression of elk use" methods detected significantly higher elk use (P=.05) in areas 1, 4, 14, 15, and 16 during 1972 compared to 1973. Both of these methods detected significantly lower elk use in area 5 for 1972 compared to 1973 during this time period. The general impression of elk use measurement for area 11 was significantly higher (P=.05) for this time period in 1973 compared to 1972. Since snow is often present during October-early November, the best measurement of elk use during this time is probably the general impression technique. Although the level of elk use for 11 subdivided areas during this time period in 1972 was significantly higher than the elk use recorded for these same areas in 1973, there was a tendency for the elk use to be similarly distributed during both of these years (Fig. 6). Elk use was not measured in areas 1 and 10 during this time period in 1973.

The distribution of elk use recorded during the fall (Sept.-early Nov.) in 1972 was compared to the distribution of elk pellet groups categorized as last year or older recorded during June in 1973. There was a tendency for these distributions to be similar (Fig. 14).

Elk-Cattle Distribution and Relationships

Cattle use and distribution within the study area appeared to be a major influence on elk use-distribution. Cattle use of the study area (reflected by both dropping counts and ocular estimation of forage use) has generally occurred in the study area between early July and mid-October for both 1972 and 1973. A comparison between the distribution of cattle and elk use in the 16 subdivided areas during various time periods in 1972 and 1973 was made in Figures 15 and 16. Elk use within some of the subdivided areas was inversely related to cattle use while elk use in others showed a positive relationship. Although some positive relationships were evident, elk use in these areas primarily occurred in segments not previously used by cattle. The occurrence of fresh elk and cattle use (droppings less than 24 hours old) at the same time within any one segment was almost non-existent.

During August, 1972, 7 percent of the total cattle use measured throughout the route system occurred in those segments recently (use since last "run" but not fresh) and/or freshly used by elk; for July-August, 1973

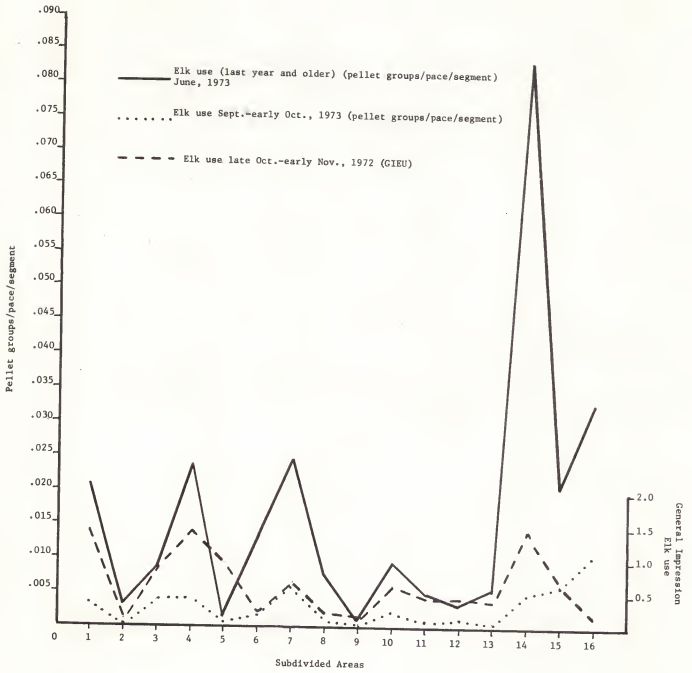


Figure 14. Comparison of elk use distribution among the 16 subdivided areas between the fall of 1972 and old pellet groups counted during June, 1973.

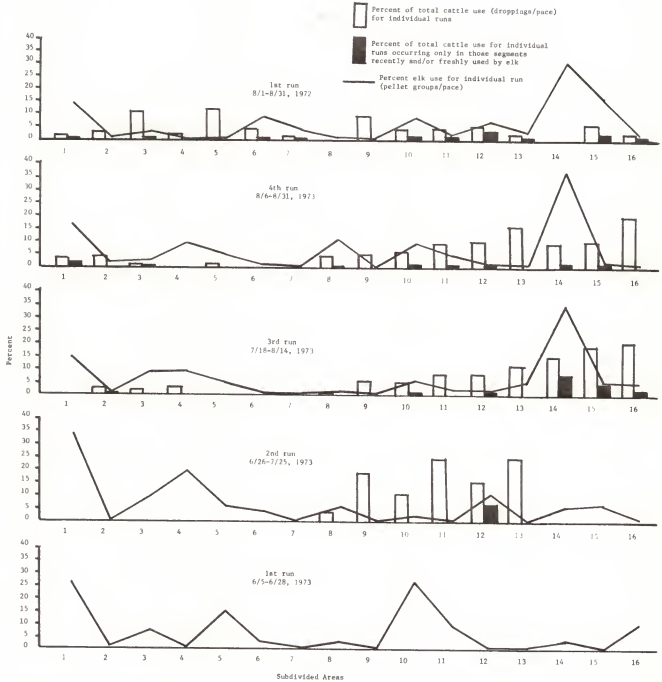

Percent of total cattle use (droppings/pace) for individual runs
Percent of total cattle use for individual runs occurring only in those segments recently and/or freshly used by elk
Percent elk use for individual run (pellet groups/pace)
1st run 8/1-8/31, 1972
4th run 8/6-8/31, 1971
3rd run 7/18-8/14, 1973
2nd run 6/26-7/25, 1973
1st run 6/5-6/28, 1973
Percent
Subdivided Areas

Figure 15. Comparison of percent elk use (pellet groups/pace) and cattle use (droppings/pace) within and between the 16 subdivided areas and comparison of total cattle use within each subdivided area with cattle use occurring only in those segments with recent and/or fresh elk use[1] for June-August, 1973 and August, 1972.

[1] fresh elk use=within previous 24 hours and recent elk use=use that has occurred since last run excluding fresh use.

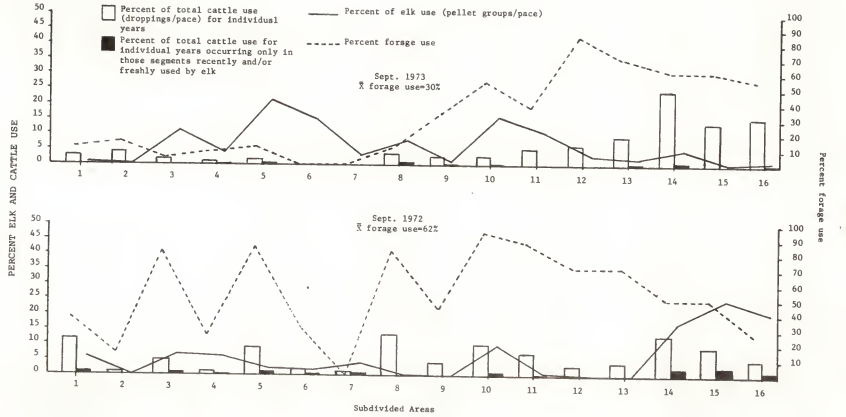

Percent of total cattle use (droppings/pace) for individual years
Percent of total cattle use for individual years occurring only in those segments recently and/or freshly used by elk
Percent of elk use (pellet groups/pace)
Percent forage use
Sept. 1973
x̄ forage use=30%
Sept. 1972
x̄ forage use=62%
PERCENT ELK AND CATTLE USE
Percent forage use
Subdivided Areas

Figure 16. Comparison of percent elk, cattle, and forage use (percent) within and between the 16 subdivided areas and comparison of total cattle use within each subdivided area with cattle use occurring only in those segments with recent and/or fresh elk use[1] for September 1972, and 1973.

[1]fresh elk use=within previous 24 hours and recent elk use=use that has occurred since last run excluding fresh use.

the average for this figure was 12 percent (Fig. 17). None of this cattle use was fresh in August 1972 and only 8 percent was fresh during July-August, 1973. These figures for September 1972 and 1973 were 10, 2, 2, and 1 percent, respectively. The above data indicate elk not only avoided segments freshly used by cattle, but also avoided segments with this years previous cattle use.

Elk seemed to prefer those segments with 0-25 percent forage use. An average of 83 percent of the route system where forage use was measured (park, broken park, and clearcut) during June-August in 1973 was assigned a forage use value of 0-25 percent and accounted for 93 percent of the total elk use during this time period (Fig. 18). In September 1972, 26 percent of the route system (paces) had a forage use of 0-25 percent and for September 1973 this percentage was 43 percent. The respective elk use of this forage use category for these time periods was 36 and 82 percent, respectively. In September 1973 elk tended to avoid those portions of the route system with forage use over 25 percent, especially the segments with forage use over 75 percent, while in September 1972 elk tended to avoid only those segments with forage use over 75 percent. Since fewer segments were available in 1972 (5 percent) than in 1973 (14 percent) with forage use estimates less than 25 percent, the elk may have had a very limited choice other than to use those segments with forage use measurements above 25 percent. By the end of September in 1972 and 1973, the average forage use of the route system was 62 and 30 percent, respectively. Four of the subdivided areas in September 1973 had forage use measurements over 60 percent, while this occurred in 7 of the areas in 1972 (Fig. 16).

Submitted By: Terry N. Lonner

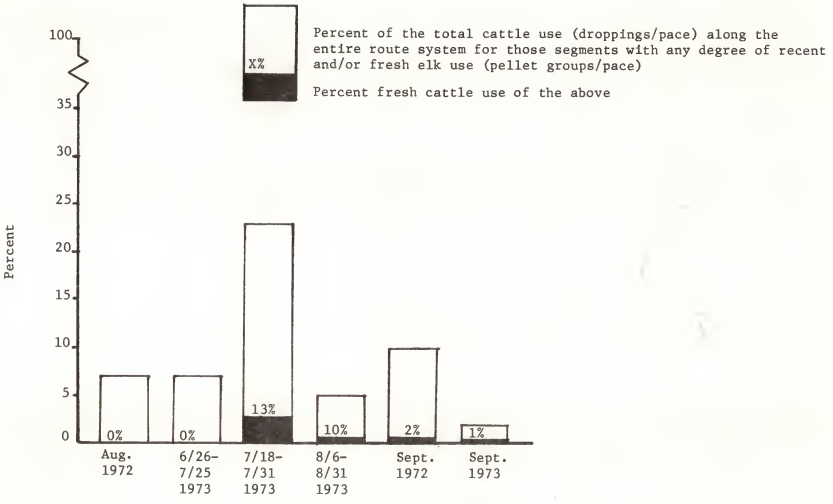


Figure 17. Percent of the total cattle use (droppings/pace) along the entire route system for those segments with any degree of recent and/or fresh elk use (pellet groups/pace).

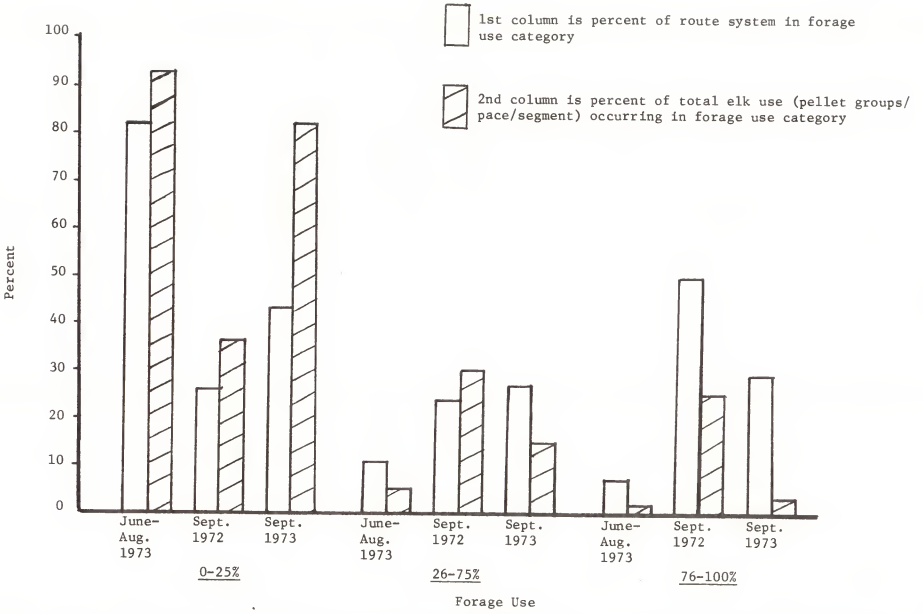


Figure 18. Comparisons of elk use (pellet groups/pace/segment) with 3 forage use categories during June-August 1973 and during Sept. 1972 and 1973.

JOB II - C
SAPPHIRE DIVIDE STUDY

PROGRESS REPORT FOR 1973 CALENDAR YEAR
July, 1974

INTRODUCTION

This study was initiated in 1970 to determine the environmental requirements of elk and the influence of forest land management on elk in the Sapphire Mountains, about 20 miles south of Missoula, Montana. Intensive field work has been carried out during calendar years 1971, 1972, and 1973, with major support coming from McIntire-Stennis funding of the Montana Forest and Conservation Experiment Station, School of Forestry and from Region 1, U.S. Forest Service. The Montana Fish and Game Department provided considerable logistic support.

Some of the results or findings are presented in the 1972 and 1973 annual reports, and master's theses have been completed by Stehn (1973) on daily movements and activities of cow elk in summer and fall and by Denton (1973) on the accuracy of our radio tracking system. Trapping during 1971-73 and all winter ecology work was carried out by R. C. Beall and his Ph.D. thesis has been completed (Beall 1974). Les Marcum is currently completing his data analysis on summer and fall habitat selection and use and his Ph.D. thesis should be completed in 1974. Ream (1974) described the rationale for the study and some preliminary findings. Some of the relationships involved are shown in Figure 1. Stankey et al (1973) described a study of hunters done on the area.

DESCRIPTION OF THE STUDY AREA

The study has been conducted on the elk herd that occupies the Threemile Game Range, a 6000 acre winter game range acquired 6 years ago by the Montana Department of Fish and Game. This game range is on the east side of the Bitterroot Valley on benchlands at the foot of the Sapphire Mountains (Figure 2). The majority of the Sapphires is in Forest Service ownership and most drainages have been roaded for timber harvest. Some of the timber harvest activity has taken place during the course of this study. Further logging will occur in the next few years and we will continue to monitor elk movements.

The winter range consists of bunchgrass and ponderosa pine habitat types with Douglas-fir habitat types on north-facing slopes. Upper elevations in the Sapphires are dominated by lodgepole pine and are mostly Douglas-fir and alpine fir habitat types.

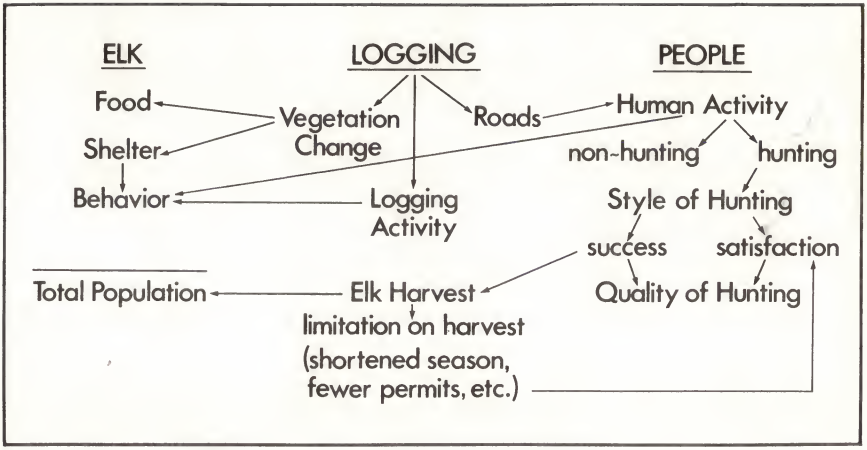


Figure 1: Relationships between elk, logging and people

(Taken from Western Wildlands, Volume 1 (1): p.23)

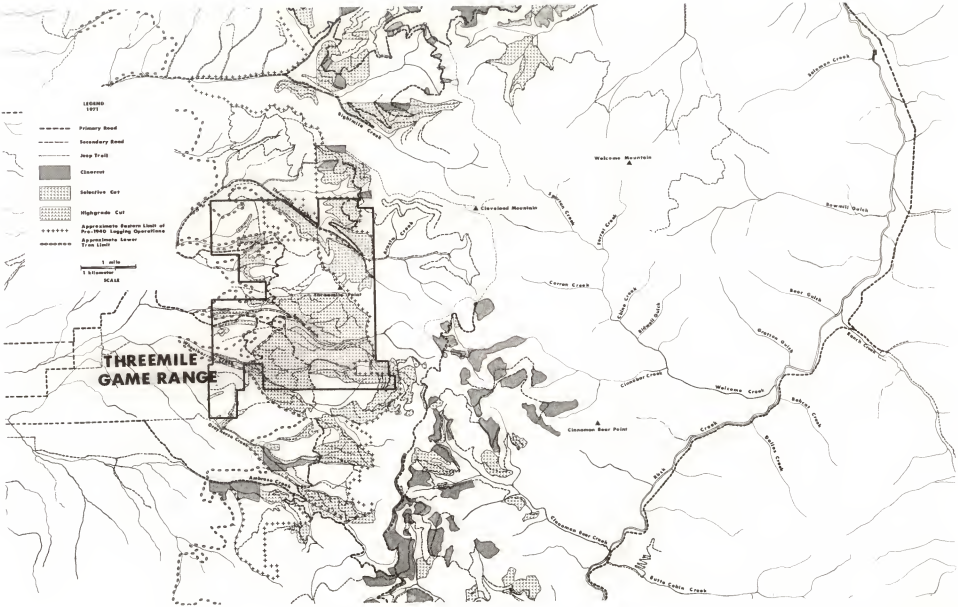


Figure 2: Sapphire Elk Study Area

METHODS

Most of our emphasis in this study has relied on utilizing radio-tagged elk to determine movements, activity patterns, and habitat use. Two corral-type elk traps were operated on the Threemile Game Range each winter and baited with hay. Trapping success was related to severity of winter, in 1972, a severe winter, 28 were trapped while in 1973, a light winter, only 8 were trapped. A total of 68 different elk have been trapped thus far in the study, some several times. Radios were placed on 35 individuals, some of which had radios replaced when they were retrapped in succeeding years. Elk not radio-tagged were marked with colored neck bands.

Most radios used were purchased from AVM Instruments, Inc., model S-2, and were powered with 4 ZM-12, or equivalent, mercury batteries. Assembly techniques will be described in a research note being prepared. Predicted life is about 2 years and several have operated for close to 30 months as of this writing.

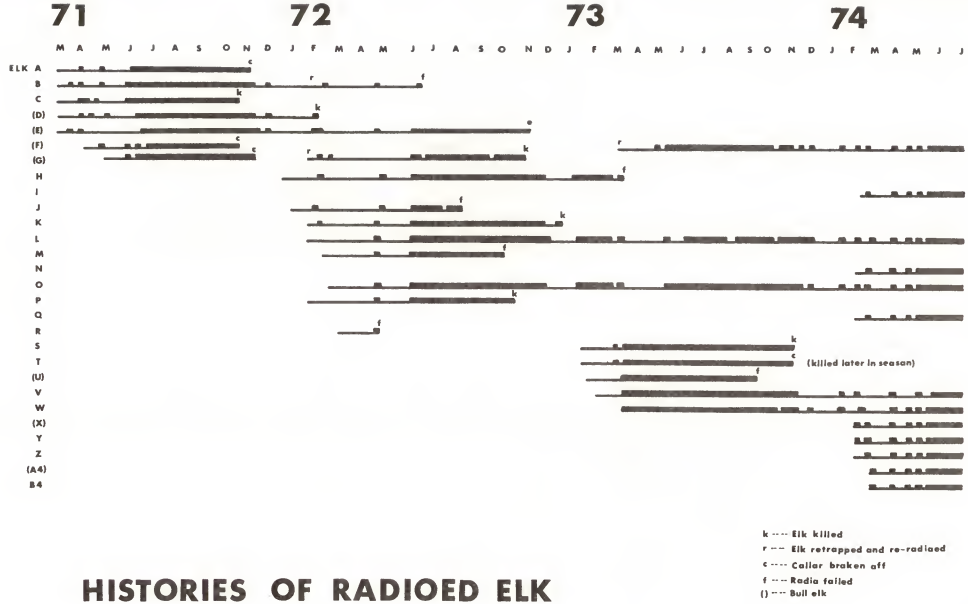
Elk were located from an airplane 2-3 times each week from May through November when elk were actively moving. From 1971 through 1973 over 200 flights have been made resulting in almost 1200 individual elk locations. The locations of all individuals located are plotted on air photos in the airplane and are later plotted on topographic maps. Elevation, aspect, slope, slope position, distance to roads and water, and other data about each location are recorded and punched for analysis.

FINDINGS

Radio Location of Elk

1. RADIO PERFORMANCE

During most of the 1973 summer-fall season 8 elk were radio-tracked. This included 6 elk radioed in 1973 as well as 2 that were still operating from 1972. Radio performance and a radio history of each elk for the entire study is shown in Figure 3. As can be seen in this figure, two or more years of data have been acquired on a number of elk, either because of radios lasting that long or because individuals have been retrapped and reradioed. Elk F, a 9 year old bull whose 1971 collar broke off in fall of 1971, was retrapped and reradioed in 1973 and is still operating. In 1971 and 1972 all collars were made of molded acrylic and several have broken off, presumably from a hard impact against something. This problem has apparently been solved by inserting the potted radio package in plastic irrigation pipe which is then heat formed to the shape of an elk neck.



HISTORIES OF RADIOED ELK

Figure 3: Time distribution for information on radiotagged elk. Heavy lines indicate weeks in which locations were obtained. Light line indicates total radio history for each.

2. ELK AERIAL LOCATIONS

During 1973, 76 flights were made, resulting in 462 elk locations, mostly from June through November. During this time period the eight radioed elk were located an average of 58 times each, roughly once every 3 days. Weather conditions and other factors affecting flying, altered the consistency of this pattern. The 1973 record of information for each elk is presented in Table 1.

Summer-Fall Range Studies

1. SEASONAL MOVEMENTS

Movements of elk during the 1973 summer-fall season were very similar to the movements observed in 1972. Elk O and Elk L, followed for the second year in a row, exhibited very similar movement patterns both years (see Figures 1 and 2 in Third Annual Report, Ream et al, 1973). Elk O again made a trek all the way to Mt. Dean Stone, overlooking Missoula, and in June, 1974 she repeated this movement for the third year in a row. Elk F, a bull radiotracked in 1971, was recaptured in 1973 and exhibited similar movement patterns in 1971 and 1973 with no data available for 1972. All three were still operating as of July 1, 1974.

Movements of the 5 individuals newly captured in 1973 (S, T, U, V, W), were very similar to those exhibited by other elk in 1972. For the third year in a row we had one cow that crossed Rock Creek and summered in the Harry's Gulch and Dallas Creek area. In 1973 Elk T crossed, in 1972 Elk M and in 1971 Elk A. Elk T lost her collar there on September 26 and was later shot. It seems unusual that all 3 individuals occupied the same drainages once they crossed Rock Creek, although the summering area is an area of seclusion and high basins or drainage heads.

Elk U, a 2 year old bull, spent most of the summer in the Welcome Creek drainage, an area where we have had a lot of elk use in the past (Figure 4). Elk W, an old cow with a calf, spent most of the summer close to the Sapphire divide (Figure 4). Although never observed on a clearcut, she spent a good deal of time in the area of the Sapphire Sale where logging was completed in 1971. Elk V, also an old cow with a calf, spent the early summer on the upper parts of the Game Range and in Threemile Creek (Figure 5). In mid-August she moved into the Welcome Creek drainage where she remained through the end of September. On October 4 she was back west of the divide where she remained in the Welcome Creek drainage through the hunting season and apparently got caught on that side by deep snows. She wintered in Sawmill Creek east of Welcome Mountain but in May, 1974 again showed up on the Threemile Game Range.

2. SUMMER RANGES

The summer ranges of 7 elk are shown in Figure 6. Although it is

TABLE 1

ELK RADIO PERFORMANCE IN 1973

Elk	Sex	Age When Trapped	Date Trapped	Number of Locations	Date Lost	Reason Lost and Other Comments	Calf
F	M	6 1/2	4/8/71		10/2/71	Probably broken off in flight	N.A.
retrapped		8 1/2	3/7/73	76	Still going	6/25/74	
L	F	4 1/2	1/30/72	54	Still going	6/25/74 (radio has functioned 29 months so far)	yes
O	F	4 1/2	2/26/72	60	Still going	6/25/74 (radio has functioned for 28 1/2 months)	yes
S	F	3 1/2	1/13/73	64	10/21/73	Elk shot--radio recovered and still operating	yes
T	F	4 1/2	1/13/73	56	9/26/73	Collar broken off (Later shot)	yes
U	M	1 1/2	1/28/73	54	9/26/73	Radio quit transmitting	N.A.
V	F	8 1/2	2/8/73	79	Still going	6/25/74	yes
W	F	10 +	3/13/73	65	Still going	6/25/74	yes

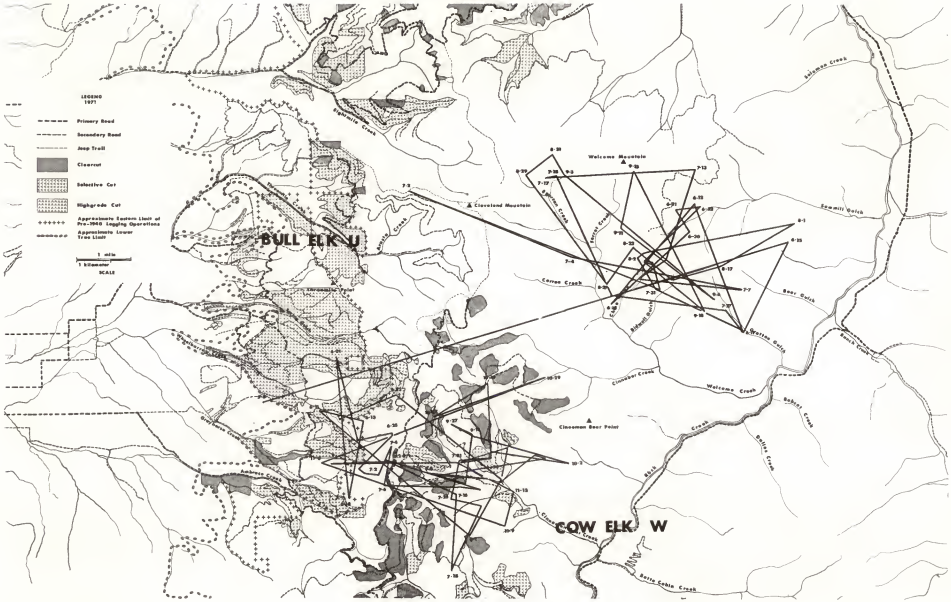


Figure 4: 1973 Movements of Elk U and W

Figure 5: 1973 Movements of Elk V

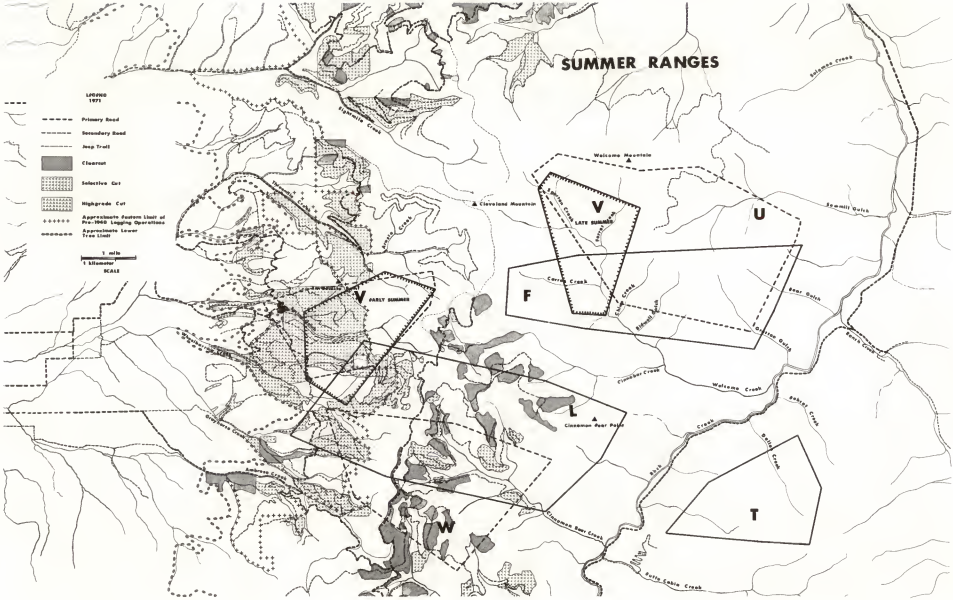


Figure 6: Summer Ranges of Radioed Elk in 1973

always difficult to delimit such a range, the area shown covers most locations from June 1 through September. In each case, a few locations may have been excluded if there was a substantial movement away from this area and back again within a week or so. Elk O was left off this map because her summer range is a good deal further north and is somewhat irregular.

3. ELK HABITAT SELECTION AND USE

During the summer of 1973 an additional sample of 69 quantitative descriptions of plant communities at elk locations were obtained, making a total of 300 samples. A map of the study area, accurately showing all roads and cuts was completed, and all elk locations from 1971 through 1973 have been plotted on it. Elk locations were related to habitat types, roads, logged areas, slope, aspect, elevation etc. We are now obtaining computerized summaries of these data, and the final report will be finished by this winter.

Table 2 gives a preliminary summary of summer-fall habitat type use by radioed elk in the Sapphire Mountains. Habitat types are according to Pfister, et al (1972). Tests for statistical significance of these data have not yet been completed, however some interesting relationships appear. During the spring and summer of 1972 the weather was relatively cool and moist. Desiccation of plants was delayed, and the elk made greater use of relatively xeric habitat types, such as the PP/Ag sp, DF/Ca ru, and DF/Ar ur types. Most of our locations of elk in clearcuts were also obtained in 1972. Conversely, more mesic to wet hydric plant communities such as the AF/Xe te, AF/Me fe, and AF/Ga tr received less elk use in 1972. These relationships are reversed for the relatively warm, dry years of 1971 and 1973.

Overall, Sapphire elk tended to use most habitat types about equal to their occurrence. The DF/Ca ru, and AF/Ga tr types appear to be selected for, while the DF/Ph ma type and clearcuts appear to be selected against.

Winter Range

A 3-year study of winter habitat selection and use by elk on the Threemile Game Range was completed by Bob Beall during 1973 (Beall 1974). It was an intensive study of environmental factors affecting habitat selection and use on the winter range (see Figure 1). Since logging occurred on the winter range during the study, observations were made on the reaction to logging and on shifts in habitat use following logging.

Table 2. Summer-Fall Habitat Type Use by Radioed Elk in the Sapphire Mountains: Preliminary Results

Habitat Type	Percent Occurrence of Habitat Type*	Percent Elk Use			
		1971	1972	1973	3 Yr. Avg.
1. PP/Ag sp	0.8	--	1.6	--	0.3
2. DF/Ca ru	4.9	4.3	10.7	5.3	6.8
3, DF/Ar uv	4.3	2.3	6.2	3.7	4.1
4. DF/Sy al	7.5	2.3	8.6	8.4	6.4
5. DF/Ph ma	10.2	2.7	6.7	6.5	5.3
6. DF/Xe te	21.8	28.8	17.7	22.6	23.0
7. AF/Va sc	6.2	9.7	5.4	6.2	7.1
8. AF/Xe te	13.0	18.7	9.7	12.7	13.7
9. AF/Me fe	17.5	18.7	15.5	17.0	17.1
10. AF/Ga tr	2.5	8.7	6.7	13.0	9.5
11. Clearcuts	2.8	--	0.5	0.3	0.3
Others	8.5	3.8	10.7	4.3	6.4
Total	100.0	100.0	100.0	100.0	100.0

1. = *Pinus ponderosa/ Agropyron spicatum*
2. = *Pseudotsuga menziesii/ Calamagrostis rubescens*
3. = *Pseudotsuga menziesii/ Arctostaphylos uva-ursi*
4. = *Pseudotsuga menziesii/ Symphoricarpos albus*
5. = *Pseudotsuga menziesii/ Physocarpus malvaceus*
6. = *Pseudotsuga menziesii/ Xerophyllum tenax*
7. = *Abies lasiocarpa/ Vaccinium scoparium*
8. = *Abies lasiocarpa/ Xerophyllum tenax*
9. = *Abies lasiocarpa/ Menziesia ferruginea*
10. = *Abies lasiocarpa/ Galium triflorum*

* Obtained by random sample of the study area

The following 6 pages are taken directly from Robert C. Beall's thesis titled Winter Habitat Selection and Use by a Western Montana Elk Herd Ph.D. Thesis, University of Montana, 1974, 197 pp.:

CHAPTER V

SUMMARY AND CONCLUSIONS

The investigation was designed to evaluate winter habitat selection and use by a western Montana Rocky Mountain elk herd. The study area was on a State-owned Game Range located approximately 35 miles south of Missoula, Montana. Data were collected from June, 1970 through March, 1973.

Elk were trapped on the Threemile Game Range four years. Each animal trapped was marked either with a colored web collar, a radio collar, or both. Animals were checked for age, sex, pregnancy, disease and general condition.

Composition counts indicated a general composition of 20 to 25 bulls per 100 adult and yearling cows, and 47 to 54 calves per 100 yearling and adult cows. If the known percentage of yearling cows is not considered, the number of calves per 100 breeding cows is approximately 67.

Twenty-two cow elk were checked for pregnancy by rectal palpation over three years. All twenty-two cows were pregnant. Two of the trapping years followed an early bull elk bugle season, which many sportsmen felt would affect elk breeding. In both years no non-pregnant cow elk were found. While these are relatively small samples, it was felt they reflect the herd situation and it would be safe to assume that the actual pregnancy rate for adult cows would approach 90 percent, or higher.

Census estimates over the three years indicate the herd is growing, perhaps 10-15 percent per year. The number of young born, compared to the number killed each fall by hunting also suggests an increase. The relatively high pregnancy-birth rate coupled with a relatively high hunter kill has produced a herd with an average per animal age of 2.4 years for males and 3.3 years for females.

Pellet group surveys to evaluate distribution and physiographic type utilization reveal that elk spend 43 percent of their time on south exposure slopes, 21 percent in open grassland feeding areas, 18 percent on north exposure slopes, and 17 percent on ridge tops. In addition, they spend 61 to 75 percent of the time on the upper one-third of the slopes.

Elk movements and habitat selection were affected by snow depths. In each winter of the study, snow depths were appreciably

different. The areas of primary elk activity shifted up or down-slope depending on the amount of snow present. The lowest elevation occupation period was in 1972, which was a deep snow year. The highest elevation occupation period was in 1973, which was a record dry year for western Montana. When snow depths approached 18 inches elk began moving lower to areas of lesser snow depth. This does not imply that elk are unable to travel in snow depths in excess of 18 inches, for elk were observed to travel through snow depths in excess of 3 feet. However, the energy expenditure apparently is such, particularly with a crust, that the animals are reluctant to travel through deep snow.

Elk do react to changing ambient air temperature and radiation conditons. Under various meteorological conditions, elk appeared to "seek out" rather specific bedding sites. During unseasonably warm, humid periods, elk movement was reduced to a minimum. Bedding sites were normally on north slopes in dense timber stands. During January, February, and March, elk are in full winter coat, and a logical explanation is that the weather was too warm for "comfort". The animal would have difficulty dissipating the excess heat generated by muscle activity, and the best solution would be to stay in a cool environment and restrict muscular activity.

Maximum movement was observed during periods of extremely cold clear weather. The need for more heat would be conducive to muscular activity. In addition, elk bedded in direct sunlight on open south slopes during these periods, and on north timbered slopes at night where protection from the clear cold sky would be the greatest. During these same periods, elk were frequently observed feeding in the evenings on open south slopes in direct sunlight. As the sun went down, and the shadows moved up slope, elk were observed to move up with them, thus staying in direct sunlight. When shadows completely covered the slope, animals dispersed, and appeared to feed at random.

During ambient temperature conditions between zero and 35°F, a normal pattern would be that daytime bedding sites are located in dense timber stands on ridge tops with a slight north aspect. Travel to feeding areas was normally 2-3 miles, with feeding periods at dusk and dawn. Nighttime bed sites were generally on open timbered south slopes, and if the feeding area was in a level open field, elk would bed within the feeding area. Night bed sites appeared to be selected for proximity to the feeding site, rather than protection from the cold.

A majority (86 percent) of bed sites evaluated were associated with dense timber clumps on the upper one-third of a slope. During colder periods, elk tended to bed on the south side of the stands during the day, and the north side at night. In warmer periods, elk tended to bed on the north side during the day, and the south side at night. If ambient radiation conditions are used rather than temperature, the regression coefficient values are considerably higher, indicating that thermal and solar radiation are important components of the elk's winter environment.

In addition to bedding within a timber stand, elk have a tendency to bed near an individual tree within the stand. The tree selected appears to be the largest tree available to elk in the immediate vicinity of the bedding site. Similarly, the position near the tree changes with changing temperature and radiation. During warm temperature ranges, elk tend to bed on the north side of trees during the day, and the south side at night. During cold ranges, the reverse is true. When radiation values are considered, the regression coefficients are again higher than the temperature coefficients.

The strongest bedding relationships found were with slope aspect, and stand density. As meteorological conditions changed, the aspect selected for bedding, and the characteristics of the stand bedded in changed. As temperature increased, elk beds shifted from south slopes to north slopes during the day ($r = -.942$), and from north slopes to south slopes at night ($r = .687$). If radiation values are considered, the regression coefficients are -.953 and .701, respectively. In addition, as temperature increased, the number of trees per acre at selected day bed sites increased ($r = .731$), and the number of trees per acre at night bed sites decreased ($r = -.651$). Radiation coefficient values were .933 and -.682 for the respective conditions and times.

It was found by tracking elk in snow, that elk may walk through as many as fifty small clumps of timber before bedding in one. It is conceivable that elk bed in those areas that "feel" confortable. By walking through numerous clumps, each one could be "evaluated" for the right micro-climate, and the first suitable one selected.

In all bed site observation analyses, where meteorological conditions were compared with site characteristics, the regression coefficients for thermal and solar radiation were higher than for ambient air temperature. This implies that radiation is a more important influence on elk than ambient temperature. Most wildlife investigations fail to evaluate this possibility, but rather, they concentrate on temperature effects. It is possible that many reactions to meteorological conditions are misinterpreted because of the lack of important radiation information.

Cloudy conditions tend to decrease the specificity of elk habitat selection. A total overcast tends to flatten out the differences between north and south sides of timber stands, and between north and south slope exposures. There was a tendency for elk to follow the same general patterns as those that occurred during clear or partly cloudy weather, but it was not as well defined.

Under cloudy conditions, elk beds were still associated with the larger trees within stands, but the aspect position of the bed was not correlated with ambient weather conditions. Regression coefficients approached zero, indicating that elk just bedded near the tree on a random basis. This weak association with aspect strongly

suggests that a psychological relationship does exist, and that elk bed near individual trees for reasons other than physiological comfort.

The differences in snow depths in 1971, 1972, and 1973 caused elk to occupy different elevations, on the Game Range, each year. However, similar habitat types are available at all elevations, and the same general selection patterns existed independent of elevation.

There was no apparent reaction to changing barometric pressure during the three years. However, periods of greatest pressure change were also periods of extensive storms. Elk shelter-seeking reactions were observed during these storms, but it was not possible to separate behavior caused by snow, high winds, or changing pressure. More than likely, it was a combination of all the factors. Once barometric conditions had stabilized at high or low values, there was not any behavioral response seen that could be directly related to barometric pressure.

In 1973, radioed elk were monitored with an activity meter. At temperatures below 32°F, elk were inactive 59 percent of the time. In the warmer spring weather, elk were inactive for only 44 percent of the time. Craighead et al. (1973) found that Madison elk were inactive 50 percent of the time in the winter, and Craighead et al. (1973) and Stehn (1973) found that elk were inactive for only 30 percent of the time in summer. Stehn also found elk to be inactive 42 percent of the time in the fall months. The shorter bedding periods found in spring and fall suggest a gradual conversion from winter to summer and back to winter habits as temperatures change. The duration of nighttime inactive periods decreases from winter to spring from 3.87 hours to 1.66 hours. This reflects the decreasing need to conserve energy. As temperature warms up, the animal is in a more favorable environment, and experiences less heat loss. Since bedding is a way to conserve energy, the need for bedding response would diminish.

Movements of radioed elk, determined by triangulation, indicated that a general pattern was that the elk bedded on higher portions of the range during the day, moved downhill to feeding areas at night, and returned to the higher areas in the morning. This pattern resulted in an average distance moved for all animals during all periods of 3.5 miles per 24 hours. The amount of movement varied from zero miles to 8.3 miles. The low movement occurred during unseasonally warm periods, and the high movements occurred during extremely cold periods. In general, the movement of elk began to increase towards dusk, with peaks from 1800 hours to 2300 hours. There was then a reduction in movement through the middle of the night, with another peak occurring during the early morning hours from 0600 hours to 1000 hours.

Elk respond to various combinations of wind velocity and air temperature. Under colder conditions (below 10°F), elk moved to shelter when wind velocities approached 15 mph. Around 15°F the elk began to seek shelter when wind velocities were in the neighborhood of 25 mph.

The general shelter-seeking response appeared to follow the -25°F wind chill thermal-line. At temperatures above freezing, wind did not seem to affect elk until velocities approached 30 mph. Elk were not observed in the open when wind velocities exceeded 30 mph. This was interpreted as a psychological response.

Initiation of logging activity caused an initial avoidance response by elk. However, elk appeared to become conditioned to logging activity and after 14 to 21 days resumed normal activity.

Altering of elk habitat by logging activity creates an adverse ecological situation which is avoided by elk for long periods of time. Areas logged on the game Range received light to medium use in winters prior to the logging. In the winter following logging, no use was made of these areas. Choice bedding sites were removed or severely altered, and movement was restricted because of large amounts of slash. Because of the after effects of logging, more use was made of areas outside the Game Range boundary than in prior years.

Timber harvest is not recommended on an existing well used elk winter range. Animals can be expected to avoid recently logged areas because of the drastic habitat change. It is conceivable that a limited use winter range can be improved by logging. However, operations must be under strict environmental and ecological controls, with the primary emphasis placed on animal habitat, rather than timber production.

An analysis of the condition and utilization of browse species, in 1971 and 1972, indicated that the greatest utilization was 25 percent on one species (service berry). Utilization on other species was generally below 20 percent, and frequently below 15 percent. Browse plants have a low frequency of occurrence, and many are in an advanced age or decadent class. The low utilization indicates that browse does not constitute a large portion of the diet of elk on this range.

Production and utilization surveys on grasses and forbs found that the percent use of representative species was below 10 percent. Native types were considerably more diverse and productive than seeded types or types grazed by livestock.

In general, food supplies are ample, and well distributed over the winter range. Because of this, it is not believed that the gross behavior patterns observed were a result of the presence or absence of food in any given area. Feeding patterns, more likely, were a result of the ease of availability of food, which would be directly related to snow depth, a result of meteorological phenomena.

Meteorological conditons between major physiographic and habitat types were found to vary significantly. The north slope-timbered type was consistently colder, with deeper snow depths than other types. As the amount of timber decreased, and the aspect shifted towards the south, temperatures increased and the snow depths decreased.

Population census estimates were generated from repeated observations of marked and non-marked elk. A modified Lincoln Index was used to arrive at a total population estimate each year. The estimates indicated that the population was increasing from 12 to 15 percent a year. The 1973 population size was estimated at 168 animals.

The high reproductive rates, coupled with the vegetation surveys, which indicate low utilization, suggest that the elk herd is well below the potential carrying capacity of the winter range. It is suggested that the cow season be eliminated or drastically reduced for two years. Based on the population information, the overall population would approach 250 head in this short time. This population size would still be well within the carrying capacity of the range, and there would be a substantial increase in the number of animals available for hunters in future years.

To allow for more precise management in this area, it is suggested that Hunting Area 26 be redefined. The northern one-third of Area 26 should be combined with the west one-half of Area 216 to form a new unit. Hunting season manipulation on this new unit could easily control the size of the over-wintering population of the Threemile Game Range.

DISCUSSION

Three years of intensive field work have been completed on the Sapphire study area. This consisted of determining locations of radio-tagged elk, 2-3 times each week during summer and fall months as well as on-the-ground field work during both winter and summer. The more intensive on-the-ground field work has been completed, and has been written up for winter work (Beall 1974). The summer field data is presently being analyzed and written up by Les Marcum.

Because of two new timber sales presently being initiated in areas of past elk use, we plan to continue monitoring elk movements and use patterns for three more years. A similar pattern of aerial location will be continued during summer and fall months, when elk are actively moving.

LITERATURE CITED

Beall, R. 1974. Winter habitat selection and use by a western Montana elk herd. Ph.D. Thesis. University of Montana, Missoula. 197 pp.

Craighead, J., F. Craighead, R. Ruff, and B. O'Gara. 1973. Home ranges and activity patterns of nonmigratory elk of the Madison drainage herd as determined by biotelemetry. Wildlife Monog. 33.

Denton, J. 1973. A radio telemetry system for elk: its use and efficiency. M.S. Thesis. University of Montana, Missoula. 77 pp.

Pfister, R., S. Arno, R. Presby, and B. Kovalchik. 1972. Preliminary forest habitat types of western Montana. USDA Forest Service Intermountain For. and Range Exp. Sta. and Reg. 1. 80 pp.

Ream, R. 1974. Wildlife, land use, and people. Western Wildlands 1:21-25.

Stankey, G., R. Lucas, and R. Ream. 1973. Relationships between hunting success and satisfaction. Trans. Thirty-eighth N. Amer. Wild. Conf.:235-242.

Stehn, T. V. 1973. Daily movements and activities of cow elk in the Sapphire Mountains of western Montana during summer and fall. M.S. Thesis. University of Montana, Missoula. 66 pp.

Submitted by: R. R. Ream
R. C. Beall
C. L. Marcum

JOB II - D
CHAMBERLAIN CREEK STUDY

The Chamberlain Creek Study is now entering its fourth year of data collection.

Field work was begun in the spring of 1971. Forty-three miles of transect lines were established. Elk and deer pellet densities, vegetative composition and cover, and physiographic variables, which may influence elk distribution or behavior were measured. These transects were established to measure elk use in relation to the vegetative and physiographic factors, which comprise their food and cover in the undisturbed study area. Timber production information was collected along these transects. This information is used in conjunction with other vegetative and physiographic data to prepare a timber inventory and management plan.

Data collection concerning elk use and timber production in the undisturbed area was reported complete in the 1971-72 report.

Additional agreements with Burlington Northern Inc. have increased the study area by 1,300 acres, and additional data must now be collected for this area (See Figure 1).

Study Area

The Chamberlain Creek drainage lies approximately 45 miles east of Missoula and drains north into the Blackfoot River. The area is bounded by the Bear Creek-Chamberlain Creek Divide on the west, the Pearson-Chamberlain Creek Divide on the east and the Cap Wallace Road on the south.

Vegetation in the study area is predominantly dense stands of lodgepole pine with variable understories ranging from dense cover of Alder, Menziezia, and Willow to more open Beargrass types.

Elevations within the study area range from 4,700 feet in the creek bottom at the north end to 6,800 feet on Chamberlain Mountain.

Elk use the study area as a part of their larger summer range. Movement of animals through Chamberlain Creek from Wales Creek, Pearson Creek, and Bear Creek commonly occurs.

STUDY METHODS

Procedure A.1.

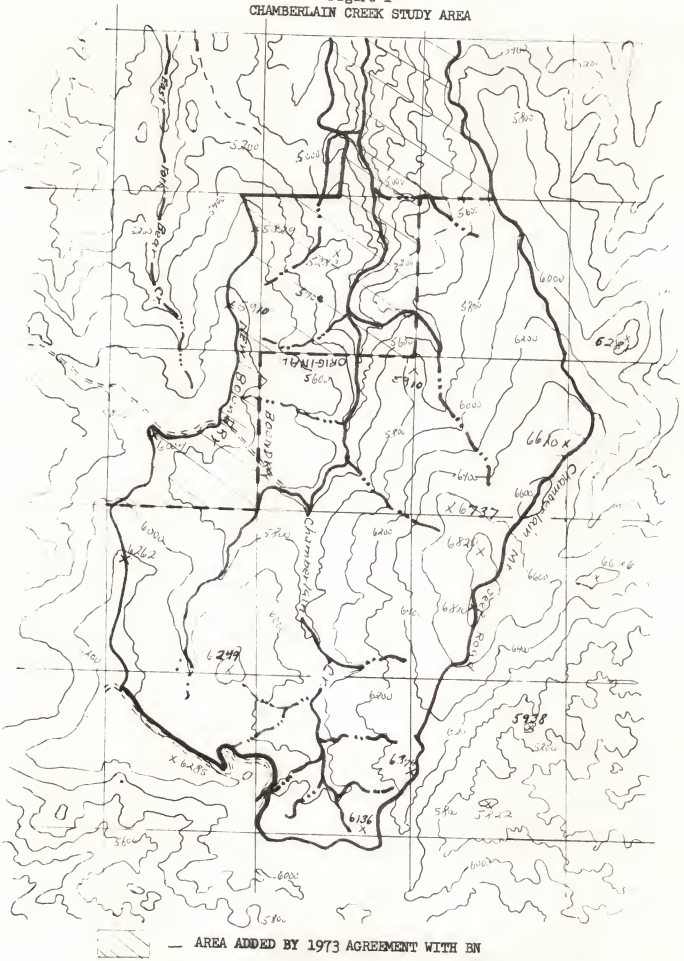
Collect timber production data for the preparation of an intensive stand inventory and analysis in the Chamberlain Creek Elk-Logging Study area.

Procedure A.2.

Prepare a comprehensive development plan for the study area based on findings from this and other studies conducted under the interagency Cooperative Elk-Logging-Road Study.

Research objectives of Procedures A.1. and A.2. have been met. The Timber Management Plan is presented in summary form.

Figure 1
CHAMBERLAIN CREEK STUDY AREA



— AREA ADDED BY 1973 AGREEMENT WITH BN

Summary of Chamberlain Creek Study Area Timber Development Plan

A. General Information

1. Topography

The Chamberlain Creek Development Plan includes approximately 4,100 acres of natural resource land, all of which is located in the Chamberlain Creek Study area.

Elevations range from approximately 4,400 feet at the north section line of section 20 in the creek bottom to 6,820 feet at the top of the ridge between Chamberlain Creek and Pearson Creek.

The terrain in Chamberlain Creek is generally characterized by its rather gentle nature. There are a few steep areas, limited mostly to the northern part along the stream. The only access roads in the drainage are a jeep trail along the Pearson Creek-Chamberlain Creek ridge and a trail into the creek bottom from Bear Creek.

2. Purpose

The primary purpose of this plan is to provide basic information about the resources within the Chamberlain Creek Elk-Logging Study area and to present an orderly sequence of activity leading to development of the area. Equally important is to meet research objectives of the Chamberlain Creek Study, Job II - D, of the Montana Cooperative Elk-Logging-Road Study.

The period covered by this plan is 10 years, continuing through 1984. This time period allows for completion of the Chamberlain Creek Study under this plan.

3. History of the Chamberlain Creek Drainage

Human activity in the study area has been limited in the past. The only significant use of the area has been made by big game hunters.

Limited access by jeep and foot trails provided for fire control, which was the only management activity in the vicinity of the study until 1965 when the Lost Larch timber sale was logged at the south end of the study area.

The most significant factor in the history of the Chamberlain Creek Drainage has been wildfire.

The drainage has been burned repeatedly. The present timber stands are the results of fires from the late 18th century through the early 20th century. Most of the present timber stands are 60 to 80 years old dating back to fires near the turn of the century.

SOILS AND GEOLOGY

Both sedimentary and igneous parent material are found in the study area.

Rocks found south of the line separating T. 13 N. from T. 14 N. are for the most part sedimentary while those north of this approximate line are almost all igneous.

The soils from the sedimentary rock are generally fairly stable while that from the igneous parent material is fine, sandy ditritus, which is highly erodible when vegetative cover is removed.

A detailed soil survey of the Chamberlain Creek area is currently unavailable; however, a projection of soil types from an adjacent township has been made to determine probable series in the study area (See Figure 2--Soil Series Map).

Description of Soil Series[1]

284 D Holloway Gravelly Loam--Moderately steep to steep on high mountain slopes. Seventy-five percent of type is 15-30 percent slope.

Vegetative cover is primarily Douglas-fir, lodgepole pine, and western larch with an understory of Beargrass, Kinnikinnick, and Vaccinium.

It is a deep, well drained gravelly loam with a moderate erosion hazard.

Trees found on this soil are moderately prone to windthrow.

284 F Holloway Gravelly Loam-- This soil is essentially like 284 D but is found on steeper slopes (30-60 percent).

Slightly increased surface runoff and erosion hazard characterize this soil, resulting in moderate limitations on heavy equipment use.

584 D Holloway-Coerock Association--This association is characterized by mountainous areas with slopes of 15-40 percent.

About 50 percent Holloway Gravelly Loam and 30 percent Coerock Gravelly Loam.

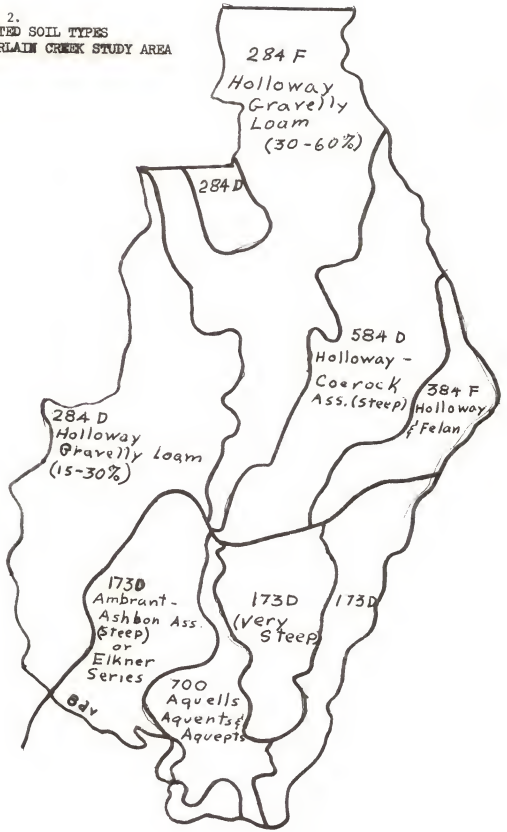
Little surface runoff and slight erosion hazard exist.

Vegetation consists of lodgepole pine, Douglas-fir, and Western larch with an understory of Beargrass, Kinnikinnick, and Vaccinium.

Plant competition may be severe and tree windthrow moderate to severe.

[1] Soil Survey, Lower Blackfoot Area, Missoula, Montana, USDA, SCS, 1972.

Figure 2.
PROJECTED SOIL TYPES
CHAMBERLAIN CREEK STUDY AREA



384 F Holloway and Felon--These soils occur on high elevation steep slopes, usually above 6,500 feet.

Timber stands on this soil are predominantly subalpine fir and lodgepole pine. Erosion and equipment hazard is moderate.

Vegetative competition may be severe after disturbance because of usual high influx of grasses. Windthrow is moderate due to high spring water content.

173 D Ambrant-Ashbon Association--This type is characterized by mountainous slopes of 15-30 percent.

About 65 percent of the association is Ambrant gravelly-sandy loam series, and 25 percent is Ashbon gravelly-sandy loam.

Surface runoff is slow, but erosion hazard is sever on steeper slopes.

In Chamberlain Creek, this may be an Elkner Series because of elevation.

700 Aquells, Aquents, and Aquepts--These soils are level to gently sloping consisting of wet areas where water is at or near the surface during much of the year. The primary resource use of these soils is the production of wildlife.

Protective Measures for Maintenance of Water Quality

1. Maintain buffer strips of "untouched" timber along creeks except at crossings.

2. Make all creek crossings with bridges.

3. Correlate time and method of timber harvest with periods of rainfall and snow melt.

4. Maintain buffers of "untouched" timber around all marshy areas.

5. Do not clear cut in large units in areas which have moderate or higher erosion hazards.[1]

6. Make all clear cut boundaries very irregular in shape.[1]

Forest Habitat Types, Timber Productivity, and Treatment Descriptions [2]

Only those units which will be disturbed during the Elk-Logging Study are described.

[1] Unit Resource Analysis, Blackfoot Planning Unit #7031, Missoula District, Bureau of Land Management.

[2] Preliminary Forest Habitat Types of Western Montana, Robert D. Phister, Steven F. Arno, Richard C. Presby, and Bernard L. Koualchik, May 1972.

Timber Cover Types and Recommended Treatments[1]

Cover type #1--General Description

Mature and overmature Douglas-fir and Western larch with some lodgepole pine, Englemann Spruce, subalpine fir, and Ponderosa pine. This cover type occupies four different habitat types, AF/xete, AF/clun, Af/mefe, and DF/caru.

Either seed tree or shelterwood cutting should be employed. Shelterwood will be used on that part of the stand occupying DF/caru and AF/xete habitat types. The more moist AF/mefe and AF/clun will be harvested by the seed tree system.

Timber volumes are approximately 14 MBF/acre, about 30 percent of which will be removed in shelterwood cutting units and 60-70 percent in seed tree units.

Seventy-two acres of shelterwood units and 100 acres of seed tree units are proposed for harvest yielding a total volume of 1,904 MBF.

Harvest Systems

1. Seed Tree--Two units totaling 100 acres will be cut leaving 2-5 trees per acre as a seed source.

Post Harvest Treatment

The soils and moist conditions of these habitat types indicate a high potential for severe vegetative competition following harvest.

Recommended post harvest treatment is to scarify the siteby piling and burning slash. Larch is the preferred species in these units and will be favored in selection of seed trees.

Overstocking prior to termination of the Chamberlain Creek study is not anticipated. Should tree competition become a factor, however, the seed trees may have to be removed prior to study termination (See Figure 3--Forest Habitat Types, Afte Phister, et al., 1972; and Figure 4--Timber Stands of the Chamberlain Creek Study Area).

Shelterwood

Remove 30-40 percent of the Basal Area in the first cutting. This will amount to 34-45 trees per acre.

The second harvest cut will be made after termination of the Chamberlain Creek Study. This cut will amount to about one-half of the remaining basal area. The final harvest will be made when the site is fully stocked.

[1] Only units planned for cutting in conjunction with Chamberlain Creek Study are included.

Figure 3

FOREST HABITAT TYPES
(Phister, et al., 1972)

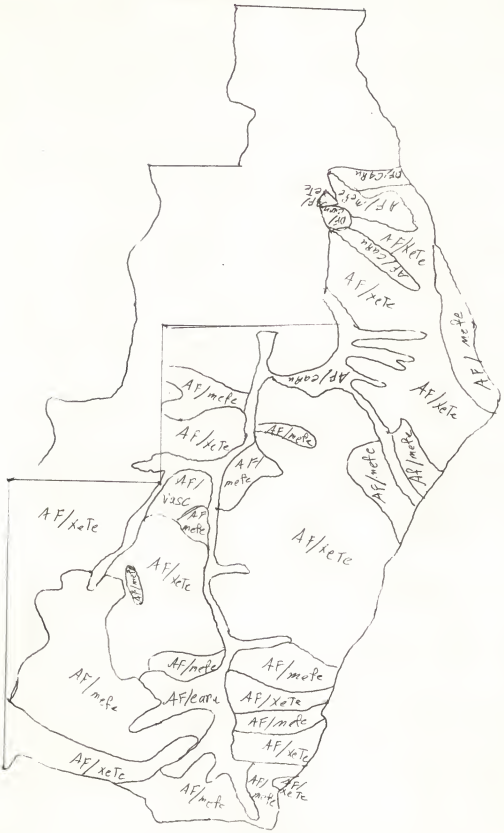
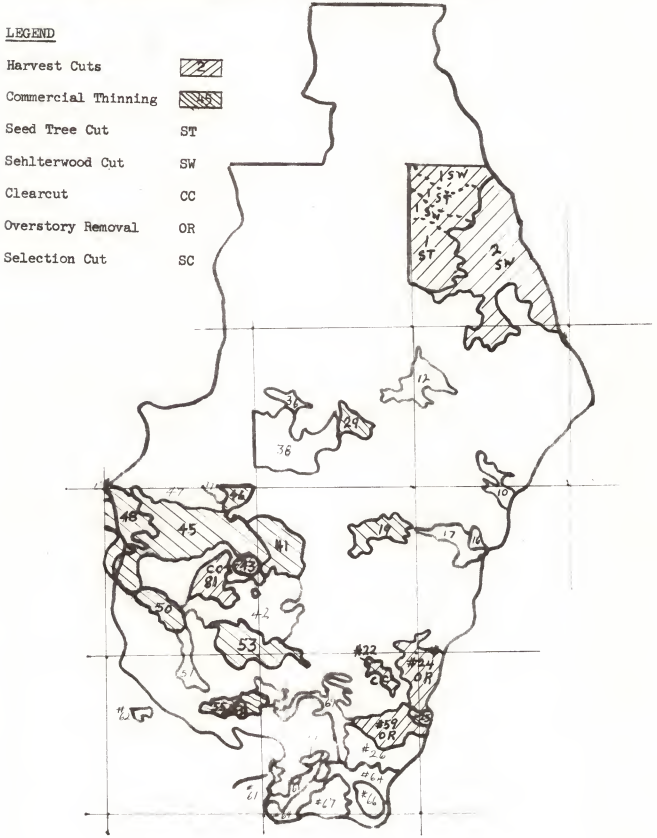


Figure 4

TIMBER HARVEST PLANNED DURING CHAMBERLAIN CREEK STUDY JOB II - D



These sites are drier than those which are planned for seed tree cutting. Severity of the site will be reduced by use of the shelterwood system.

Grasses are expected to cause a problem of competition with timber reproduction. This will be minimized by maintaining a shaded surface.

Douglas-fir will be favored under this system unless adequate light allows larch and lodgepole pine to establish.

Logging slash will be lopped and scattered. No site preparation is planned in addition to normal disturbance of logging.

This will provide adjacent areas with distinctly different slash disposal techniques for research purposes.

Cover Type 2

Composition is principally lodgepole pine and Douglas-fir, with about one-half of the volume being western larch, Englemann spruce, and subalpine fir.

The stand has a volume of 12 MBF/acre over three habitat types; AF/clun, AF/mefe, and AF/xete, most of which is the AF/xete type.

The dryness of the AF/xete type dictates the use of a shelterwood system. This system is recommended over this entire cover type, however, a seed tree system could be employed in the small AF/mefe and AF/clun types, where 2-5 larch seed trees/acre are available.

The timetable for 2nd and final harvests will be the same as described for stand #1. Total volumes to be removed will be 580 MBF or approximately 30-40 percent of the present basal area.

Site preparation in addition to disturbance of logging is not anticipated. Slash disposal will be by lop and scatter.

Cover Type 22

This is a mature stand of lodgepole pine. Additional species in this stand are in negligible quantity. The stand is entirely within an AF/mefe habitat type, and is on a uniform, west facing, gentle slope with an erodible soil.

Recommended cutting and slash disposal is to clearcut and broadcast burn.

The stand is located at midslope approximately one-fourth mile from Chamberlain Meadows thus offering adequate buffer for the wet site.

This unit is limited to 10 acres in size on 12-15 percent slope and will be cut with an irregular edge to minimize effects on runoff and the water table in the meadow below.

Broadcast burning of slash is recommended for the following reasons.

1. Minimize erosion hazard and surface runoff.

2. Initiate seed dispersal for lodgepole pine.

3. Provide a different treatment for research investigation.

Expected volume from this stand is 200 MBF.

Cover type 24
This type occupies AF/mefe and AF/xete habitat types.

The stand is located on erodible soils above the Chamberlain Meadows. These factors coupled with adequate existing reproduction under an overstory of decadent trees indicate that an overstory removal system should be employed. In this unit healthy mature trees should be left and all reproduction will be favored.

If, however, leaving mature overstory will be a source of mistletoe infestation in the reproduction, then a total overstory removal should be made. Should mature overstory not need to be removed this would be more accurately described as a selection cut.

It is planned to remove about one-half of the merchantable volume or about 384 MBF over a 48 acre area. Slash will be lopped and scattered.

Cover type 59
This type is similar to type 24 and same recommendations apply.

The type extends to the creek and meadows requiring that the boundary of the cutting unit be short of this area to provide adequate buffer for the creek and big game use.

Thirty-four acres are included in this unit yielding about 238 MBF.

Cover types 43 and 81
These two types are combined because of similarities and they are adjacent to each other. The stand is Englemann spruce and lodgepole pine occupying AF/mefe and AF/xete habitat types on erodible soils and gentle slope.

This type will be clearcut because of species composition. A buffer of "untouched" timber will be left two chains from the creek bordering the type.

Slash disposal will be by broadcast burning to minimize soil damage.

This should provide adequate seed bed in the AF/mefe habitat type.

Should piling and burning be necessary in the AF/xete type, western larch, and lodgepole pine must be planted the following spring to assure minimum soil movement.

Commercial Thinning
Only stands having average DBH of eight inches or more are being considered for commercial thinning.

Special emphasis on landing and skid road location. These should be laid out as part of the sale layout.

Table 1. For the purpose of this report commercial thinning areas are presented in the following table.

Cover TYPE No. 1/	Acres	Pres. Vol/A	Pres. BA/A	BA after thinning	BA remov.	V-bar	Vol Cut/A	Total Vol. Cut	Ave DBH	Pres Tree/A	Cut Tree/A	Type Description
19	27	17 M	158	112	46	108	5 M	135 M	8"	452	138	AF/xete,erodible, 20-30% slope
25	6	13 M	166	105	61	77	5 M	30 M	8"	476	174	AF/mefe-AF/xete,erodible flat, LLP
29	22	15 M	133	120	13	114	2 M	44 M	8"	381	38	AF/xete-AF/mete, steep 2 ch buffer on creek
41	55	17 M	184	117	67	93	6 M	330 M	8"	527	192	AF/xete,erodible, 2ch. buffer along creek & rd.
45	198	19 M	182	138	44	106	5 M	990 M	8"	521	126	AF/xete-AF/clun, erodible buffer on cr, no cutting in AF/clun
46	17	13 M	120	100	20	108	2 M	34 M	8"	384	57	AF/xete,stable soil,AF/clun leave AF/clun as buffer
48	51	14 M	147	120	27	98	3 M	153 M	8"	466	86	AF/xete, stable soil
50	26	15 M	168	120	48	98	5 M	130 M	8"	533	152	AF/mefe,stable soil,leave 2 ch buffer along creek
53	60	17 M	190	122	68	98	7 M	420 M	8"	603	215	AF/xete-AF/mefe,erodible gentle slope, lv 2 ch buffer along road
55	21	21 M	234	123	111	83	9 M	189 M	8"	742	352	AF/mefe, erodible, gentle slope, moist, buffer along road
63	5	15 M	160	120	40	115	5 M	25 M	9"	362	90	Same as 55
Total	488							2,480 MBF				

1/ Cover type map fig. #

Special emphasis should be placed on removal of high risk and deformed trees.

Slash disposal should be by lop and scatter method; however, if quantities are very high piling and burning may be necessary.

Road Construction

	Road Improvement	New Construction	
		Mainline	Spur
During Study	27,900 ft.	28,000 ft.	75,000 ft.
Total	27,900 ft.	28,000 ft.	93,000 ft.

Location of roads in relation to elk distribution are shown in Figure 5.

The entire road system is to be kept closed. The mainline road will be blocked at the north section line of section 20, T. 14 N., R. 13 W.

It is recommended in this plan that the mainline road not be constructed to the existing Lost Horse Mountain Road in order to control access and eliminate a loop system.

The mainline road is to be a 14 ft subgrade with maximum 75 ft radius curves, in order that primary purposes may be served with minimum land disturbance.

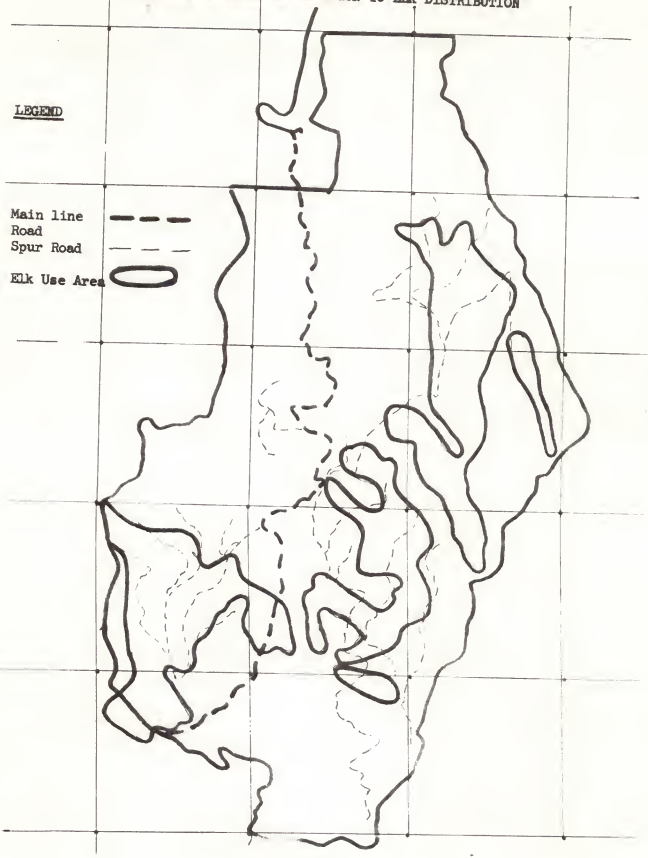
General Recommendations

1. Provide buffer strips of untouched timber two chains in width between any road and a perennial stream.

2. Provide buffer of untouched timber two chains wide between any cutting unit and a perrenial stream.

3. Withdraw the area from mineral entry for the life of the Chamberlain Creek Study. This, and the following item may be accomplished through offroad vehicle regulations.

Figure 5
LOCATION OF ROADS IN RELATION TO ELK DISTRIBUTION



4. Close the area to all vehicles other than for the purpose of timber harvest and administration.

   Winter use which is not in conflict with elk may be allowed.

5. Locate and construct all roads to fit topography and at the minimum standard required for the planned purpose with as low a grade as possible.

6. All main stream crossings should be by bridge.

7. Time timber harvest to periods which minimize impacts on other resources.

8. Feather all clearcuts and design irregular edges to minimize aesthetic impact and improve utility to big game.

9. All disturbance to be completed in a 30-month period.

10. All recreation access to be restricted to foot only during the time which elk are in the area.

11. Withdraw all stream buffers, marsh, and meadow area or other lands identified as critical to other resources from the timber management land base.

12. Slash disposal on 5.3 miles of mainline road.

13. Prohibit timber harvest or road construction activities during the hunting season.

Procedure B

To describe cover and forage use by elk before, during, and after habitat alteration through road construction and timber management activities.

B.1.
Describe elk distribution through pellet deposition records.

B.1.a.
Conduct pellet counts to determine general distribution of elk in the study area.

(1) Establish transect lines along which pellet deposition is recorded. Lines are placed at each 200 foot increment of elevation. Pellets are counted and recorded for each four-chain segment of transect.

   Pellet densities for each segment are recorded as a dependent variable for regression analysis against independent vegetative and physiographic variables.

   (a) Percent vegetative ground cover

   (b) Percent secondary cover (shrub & trees 5-15 ft high)

   (c) Percent overstory canopy cover (over 15 feet high)

(d) Vegetative composition of each stage of cover

(e) Composition of shrubs and trees under 5 ft in height

(f) Composition of herbaceous understory

(g) Forest habitat type--Afte Phister, et al.

(h) Distance to free water in 1/8 mile increment

(i) Percent slope

(j) Aspect in eight points

(k) Elevation in hundreds of feet

(l) Number of trees/acre

(m) Average DBH of trees/sample plot.

Field work has been completed for the initial area of study.

A new agreement with Burlington Northern Inc. has expanded the study by 1,300 acres. This additional acreage must now be studied.

Analysis of the above described data has not been accomplished.

A contract is currently being negotiated to complete this analysis during the coming year.

(2) Supplemental pellet group counts were made along the Chamberlain "jeep" road to determine if this "trail" influences elk behavior in reference to cover requirements.

Pellet deposition was recorded along transects located at $\frac{1}{8}$-mile intervals along the trail running at right angles to the trail.

Each two hundred feet of transect was considered a sample plot and a horizontal visibility class was assigned to each plot.

Visibility classes used for this purpose are:

(a) less than one chain..... Class 1
(b) one-two chains..... Class 2
(c) two-three chains..... Class 3
(d) three-four chains..... Class 4
(e) more than four chains..... Class 5

Visibility classes were estimated by the recorder.

Elk occurrences were mapped together with visibility classes, to obtain a relationship between elk use and screening cover along the Chamberlain Mountain "jeep" trail.

B.1.b.
Locate and measure trend plots to determine elk use of planned areas of disturbance before, during, and after logging.

No work was done on this procedure during the reporting period.

B.2.
Determine food habits by Rumen analysis.

Fall samples have been measured two years.

Samples show predominantly carex and grasses in the diet in late October. Breakdown of food by forage type shows 8.6% browse, 65.1% carex, and 21 % grass.

Procedure C

Record and describe changes in elk forage and cover relationships, which are caused by timber management activities.

C.1.
Complete a vegetative analysis of the study area.

Data collection is complete for the original area of study.

Analysis of this data is pending relationships between vegetation and physiographic variables have not yet been determined.

Vegetative communities or associations will be computor analysed.

Procedure D

Establish a check station at Scotty Brown's bridge to obtain knowledge of elk harvest and hunter distribution in the study.

The check station was manned only during the first two weekends of the 1973 hunting season. Two hundred and ten hunters were interviewed. Information was collected under procedure appears in the following table.

Table 2 Hunter Information Scotty Brown Check Station

Location	Number of Hunters	Miles Road Hunted	Miles Walked	Number Elk Seen	Number Deer Seen Mule Deer	Wh.T. Deer	Game Killed
Pearson Creek	36	27+	35	8	12	12	2 M. deer 1 Wh.T.
Chamberlain Pearson Ridge	19	40	20	6	5	8	
Chamberlain Creek	76	78+	48+	1	15	9	4 Wh.T. 1 elk
Blacktail Mountain	34	39+	37+	21	26	9	2 m. deer 1 Wh.T. 1 elk
W. Fork Chamberlain & Bear Creek	11	20	10	1	2		
Dunigan Mountain	8	20	3+	1	2		
Green Mtn Granite Mt.	7	20	9+	3	3		1 m. deer
Blackfoot River bottom	19	23+	1+	—	7	4	1 m. deer
Total	210	267+	163+	40	115		15

Table 3

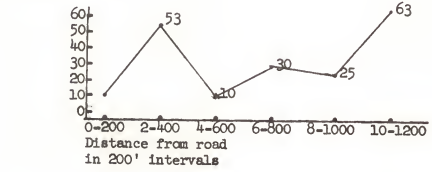
Distance Traveled	Number of Hunters	Number of Parties	Average Number Hunters/Party
Local	15	6	2.50
< 50 miles	138	76	1.82
> 50 miles	31	18	1.72
Out of State	19	9	2.11
Unknown	7	2	3.50
Total - Average	210	111	1.89

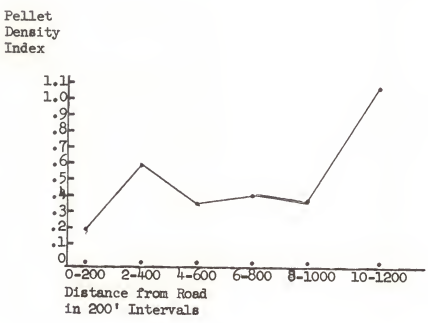
FINDINGS

Average density of pellet groups along the road showed little or no use within 200 feet except in two areas which appear to be crossing points. The only area which showed use in an area of high visibility adjacent to the road is a steep south facing slope into Wales Creek, which is screened by topography.

At 200-400 feet from the road a peak in use occurred followed by a sharp drop from 400 ft to 1000 ft. At approximately $\frac{1}{4}$ mile from the road maximum use occurred.

Disregarding density of use and using all areas where any use was evident, the same general pattern was found.





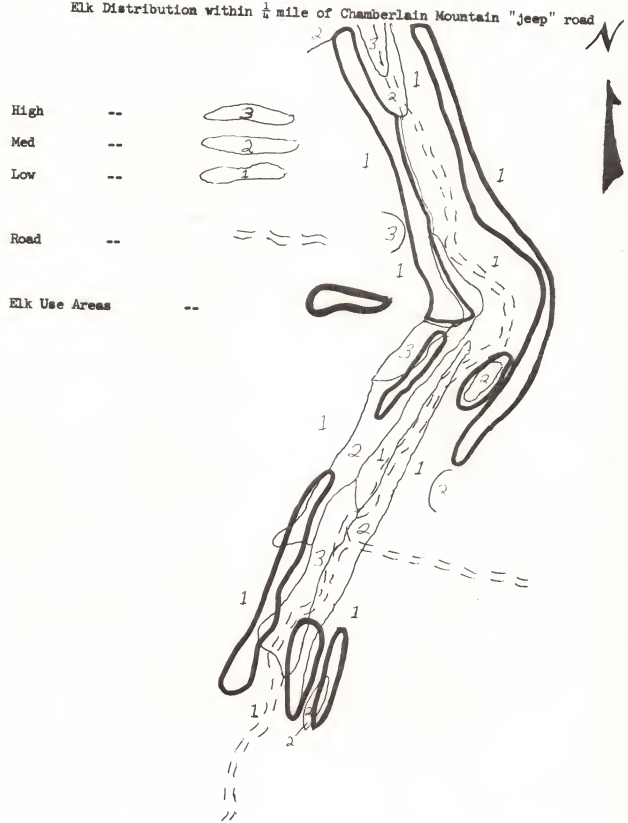
The above graphs indicate that the road is influencing elk behavior at least within the $\frac{1}{4}$ mile "belt" either side of the road.

There appears to be a "belt" 200-400 ft either side of the road in which elk spend relatively more of their time. Whether this indicates a tendency for elk to parallel the road to preferred crossing points or whether elk are approaching to this distance and hesitating there before crossing is unknown. It is also unknown whether this influence extends farther from the road than $\frac{1}{4}$ mile or whether gross distribution and movements are being influenced.

Submitted By: Richard Ellison

Figure 6

Elk Distribution within $\frac{1}{4}$ mile of Chamberlain Mountain "jeep" road



JOB III-A.1

Ruby Road Closure Study

Progress Report for the Period
January 1, 1973-December 31, 1973

INTRODUCTION

The objective of this study was to determine the effect of restricted hunter vehicle access on the distribution and response of hunters and on the behavior and harvest of elk in a portion of the Upper Ruby River drainage of southwestern Montana.

The 1973 hunting season was the fourth and final data collection period of the study. The 1970 and 1971 hunting seasons comprised the pre-closure phase of the study while the 1972 and 1973 hunting seasons comprised the closure phase. During the closure phase, travel restrictions imposed on the upper unit of the study area excluded all motor vehicles; except, mechanized travel was permitted on a road surrounding the unit and on 5 roads which provided limited penetration (Fig. 1).

DESCRIPTION OF THE STUDY AREA

The study area was located in the Gravelly Mountains near the headwaters of the Ruby River, which separates the Gravelly Mountains from the Snowcrest Range in Beaverhead and Madison Counties. The area was essentially a combination of coniferous forest, aspen timber, sagebrush and grassland types. It is characterized by large expanses of sagebrush-grassland types with various sized "islands" of timber scattered throughout (Fig. 2).

FINDINGS

Hunting Pressure

During weekends of the 1973 hunting season a total of 2,538 hunters were checked at the Ruby check station. This total was 11 and 10 percent fewer than the totals checked in 1970 and 1971, respectively, and 7 percent more than the total checked in 1972 (Table 1). The number of hunters checked per operating day (211) of the check station in 1973 was 11 percent fewer than was checked in 1970 while this same number was 6 and 7 percent more than was checked in 1971 and 1972, respectively. Forty-five percent of the total number of hunters checked during the entire study were checked the first week of the season (opening day through the following weekend) (Table 2). Apparent traffic counter

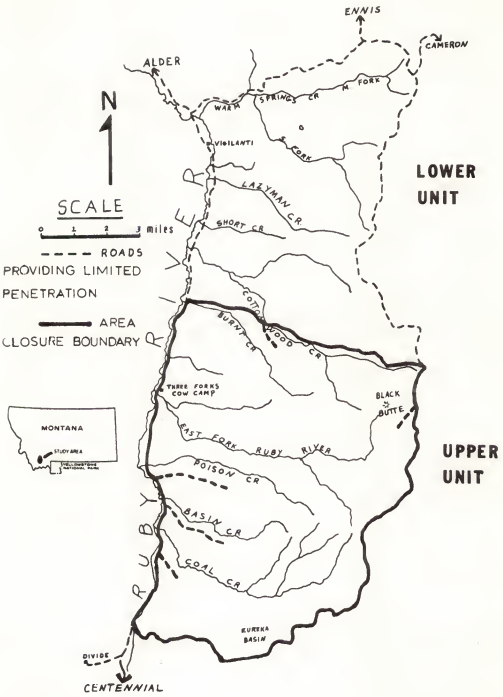


Figure 1. Upper Ruby Study Area.

Figure 2. A portion of the Ruby study area showing the interspersion of sagebrush-grassland and timber types.

Table 1. General hunting pressure statistics from data collected for the entire Upper Ruby River Drainage for 1970, 1971, 1972, and 1973.

	1970	1971	1972[1]	1973[1]	Avg. of all Years
Number vehicles (traffic counter)	9,265	8,421	7,259	5,454[2]	7,600
Number vehicles/season day	215	198	202	152[2]	192
Weekend hunters checked	2,820	2,803	2,364	2,534	2,577
Hunters checked/operating day	235	200	197	211	210
Average number hunters/party	2.8	2.9	3.0	2.7	2.9

[1]Season one week shorter than 1970 and 1971.
[2]Underestimated due to traffic counter malfunctioning.

Table 2. Number of hunters and number of elk checked during opening week of general big game season.

	Opening Week				
	1970[1]	1971[2]	1972[2]	1973[2]	Total
Number of hunters	1243	1050	1090	1353	4736
Percent of season total	44	37	46	53	45
Number of elk checked	86	48	42	60	236
Percent of season total	82	63	61	74	71

[1]Check station operated 3 days.
[2]Check station operated 4 days.

malfunction prevented valid comparison of data collected in 1973 with data collected during the 3 previous years. The average number of hunters per hunting party ranged from 2.7 in 1973 to 3.0 in 1972 with an average of 2.9 for all four years.

Nineteen and 2 percent fewer hunters were checked from the study area in 1973 than in 1970 and 1971, respectively, and 24 percent more hunters were checked than in 1972 (Table 3). Since open road and favorable weather conditions did not hinder hunter activities in 1972 and 1973, the above data, and that presented in Table 4, indicate the road closure restrictions imposed on the upper unit of the study area in 1972 and 1973 may have been the major factor causing a decline in hunter use of that area during these years. More hunters hunted the upper unit in 1973 than in 1972 indicating these restrictions either selected for foot and horse hunters and/or changed hunting methods of those hunters who hunted the upper unit before road closure restrictions were initiated. Hunter origin statistics did not appear to significantly change throughout the study except for non-resident hunters, which progressively increased from 5 percent in 1970 to 10 percent in 1973 (Table 5).

Table 5. Hunter origin for all 4 years of the study.

Origin	1970	1971	1972	1973
Butte-Anaconda	61[1]	59	60	53
Madison County	13	13	12	11
Non-resident	5	6	7	10

[1]Percent of season total hunters checked.

Hunting pressure within the study area was more uniform throughout the 1972 and 1973 seasons compared to the 1970 and 1971 seasons. Sixty-seven and 65 percent of the hunting pressure in the study area was recorded the first half of the 1972 and 1973 seasons, respectively, while 80 percent was recorded the first half of both the 1970 and 1971 seasons (Table 4). A slight shift in hunting pressure occurred between the upper (closure) and lower (control) units. The proportion of study area hunters hunting the upper unit declined from 50 and 57 percent in 1970 and 1971 to 44 and 49 percent in 1972 and 1973. The increased use in 1973, over 1972 may have reflected increased hunter awareness and acceptance of the closure. At least 90 percent of all the hunters interviewed during the closure years approved of the closure; many of these hunters indicated that the relative quality of their hunting experience had been enhanced by the closure.

Table 3. Hunting pressure statistics for 1970, 1971, 1972, and 1973.

Weekend	TOTAL HUNTERS								STUDY AREA HUNTERS											
	Number				Percent Season Total				Number				Percent Total Hunters				Percent Study Area Season Total			
	1970	1971	1972[1]	1973[1]	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973
1	665	777[2]	714[2]	869[2]	24	28	30	34	310	333	221	305	47	43	31	35	35.0	45.0	38.0	42.0
2	578	485	376	484	20	17	17	19	203	135	98	95	35	28	26	20	23.0	18.0	17.0	13.0
3	394	306	288	287	14	12	12	11	123	74	75	72	31	24	26	25	14.0	10.0	13.0	10.0
4	341	234	308	272	12	8	13	11	83	41	71	71	24	17	23	26	9.0	6.0	12.0	10.0
5	349	293	292	296	12	10	12	12	80	50	48	105	23	17	16	35	9.0	7.0	8.0	15.0
6	276	276	389	330	10	10	16	13	59	56	71	74	21	20	18	22	6.0	8.0	12.0	10.0
7	217[3]	432	-	-	8	15	-	-	36	47	-	-	17	11	-	-	4.0	6.0	-	-
TOTALS	2,820	2,803	2,364	2,538					894	736	584	722	32	26	25	28				

[1]Season one week shorter.
[2]Station operated both Sunday and Monday; Monday was a holiday in 1972 and 1973--more hunters checked out than on opening day.
[3]Station operated only 1 day.

Table 4. Hunting pressure statistics within the study area, 1970, 1971, 1972, and 1973.

Unit and Portion of the Season	Number of Hunters				Percent of Season Total in Upper or Lower Unit				Percent of Season Total Study Area Hunters			
	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973
Upper Unit												
First Half[1]	383	356	181	254	85	85	70	72	43	48	31	35
Second Half[2]	65	64	76	97	15	15	30	28	7	9	13	14
Entire Season	448	420	257	351	-	-	-	-	50	57	44	49
Lower Unit												
First Half	332	227	213	218	74	72	65	59	37	31	36	30
Second Half	114	89	114	153	26	28	35	41	13	12	20	21
Entire Season	446	316	327	371	-	-	-	-	50	43	56	51
Total Study Area												
First Half	715	583	394	472	-	-	-	-	80	80	67	65
Second Half	179	153	190	250	-	-	-	-	20	20	33	35
Entire Season	894	736	584	722	-	-	-	-	-	-	-	-

[1]Includes 4 weekends in 1970 and 1971, and 3 weekends in 1972 and 1973.
[2]Includes 3 weekends all years.

In both 1970 and 1971, 15 percent of the season long hunting pressure occurred during the second half of the season in the upper unit, while in 1972 and 1973, 30 and 28 percent of the season long hunting pressure occurred during this same time period - 2.0 and 1.9 times more than that in 1970 and 1971 (Table 4). During the second half of the season in the lower unit the hunting pressure was 27 percent (average between 26 and 28 percent) for both 1970 and 1971, while in 1972 and 1973 the hunting pressure was 35 and 41 percent - 1.3 and 1.5 times more than that in 1970 and 1971. These data may indicate the road closure restrictions imposed on the upper unit of the study area during 1972 and 1973 played a major role in making the hunting pressure in the entire study area more uniform throughout the season.

Elk Harvest

A total of 81 elk were checked at the check station in 1973 compared to 69 in 1972, 76 in 1971, and 105 in 1970. During the 4 years of the study an average of 71 percent of all elk checked at the check station was recorded during the first week of the season (Table 2). Thirty nine elk, or 47 percent of the season's elk harvest, came from the study area in 1973 and compares to 54, 40, and 63 percent in 1972, 1971 and 1970, respectively, (Table 6).

In the upper unit of the study area an average of 7 percent of the elk killed in that unit occurred the last half of the season in 1970 and 1971 while this average was 31 percent for 1972 and 1973. In the lower unit of the study area an average of 8 percent of the elk harvest occurred the last half of the season in 1970 and 1971 while this average was 26 percent for 1972 and 1973 (Table 7) (Figs. 3 and 4).

Study area hunter trip success was 5 percent in 1973 compared to 6 percent in 1972, 4 percent in 1971, and 7 percent in 1970 (Table 7). Within the restricted portion of the study area for the last half of the season, a total of 4 elk were bagged during the 1970-71 hunting seasons to give an average hunter trip success of 3 percent, while during the 1972-73 hunting seasons a total of 13 elk were bagged to give an average hunter trip success of 8 percent.

These findings suggest the road closure restrictions applied to the upper unit in 1972 and 1973 were probably a major influencing factor for this increase in both elk harvest and hunter trip success during the second half of these seasons. The closure restrictions appeared to increase the capability of the area to "hold" elk for a longer period of time and/or the foot and horse hunting methods necessary for hunting elk gave the individual hunter in that area a better chance to bag an animal. Comparatively milder weather conditions during these 2 hunting seasons could also have been an influencing factor.

Table 8 lists the sex and age of all elk checked during the 4 years of the study. This table includes data collected from weekend check

Table 6. Summary of 1970, 1971, 1972, and 1973 elk harvest data collected at weekend checking stations.

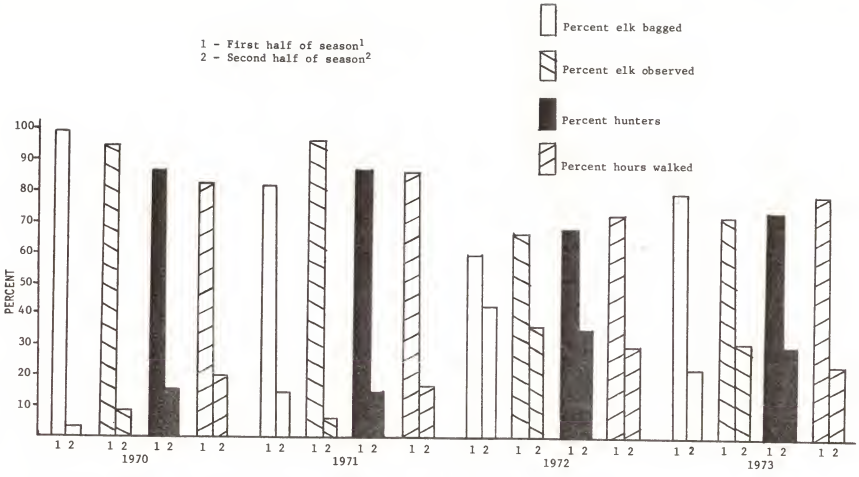
Weekend	TOTAL ELK CHECKED								ELK CHECKED FROM STUDY AREA											
	Number				Percent Season Total				Number				Percent Total Elk				Percent Study Area Season Total			
	1970	1971	1972[1]	1973[1]	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973
1	58	25[2]	32[2]	44[2]	55	33	46	54	48	13	17	31	46	17	25	38	73.0	43.0	45.0	79.0
2	28	23	10	16	27	30	15	20	13	8	4	2	12	11	6	2	20.0	27.0	11.0	5.0
3	6	7	1	4	6	9	2	5	0	4	0	0	0	5	0	0	0.0	13.0	0.0	0.0
4	4	3	5	4	4	4	7	5	2	1	3	2	2	1	4	2	3.0	3.0	8.0	5.0
5	2	8	9	4	2	11	13	5	1	2	5	1	1	3	7	1	1.5	7.0	14.0	3.0
6	3	5	12	9	3	7	17	11	1	0	8	3	1	0	12	4	1.5	0.0	22.0	8.0
7	4[3]	5			4	7			1	2			1	3			1.5	7.0		
TOTALS	105	76	69	81					66	30	37	39	63	40	54	47				

[1]Season one week shorter than 1970 and 1971 seasons.
[2]Station operated both Sunday and Monday; Monday was a holiday in 1972 and 1973--more hunters checked out than on opening day.
[3]Station operated only 1 day.

Table 7. Hunters, elk bagged, and hunter success as determined from check station information, 1970, 1971, 1972, and 1973.

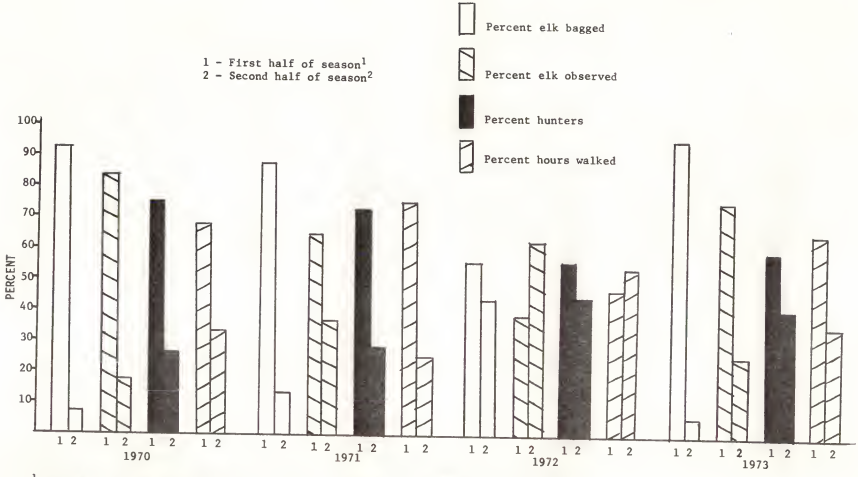
Portion of Hunting Season	Upper Unit (Restricted)				Lower Unit (Unrestricted)				Entire Study Area			
	1970	1971	1972[1]	1973[1]	1970	1971	1972	1973	1970	1971	1972	1973
First Half[2]												
No. of Hunters	383	356	181	254	332	227	213	218	715	583	394	472
No. Elk Bagged	37	19	11	18	26	7	10	15	63	26	21	33
Percent Elk Bagged	97	86	58	78	93	86	56	94	95	87	65	85
Percent Trip Success	10	5	6	7	8	3	5	7	9	4	5	7
Last Half[3]												
No. of Hunters	65	64	76	97	114	89	114	153	179	153	190	250
No. Elk Bagged	1	3	8	5	2	1	8	1	3	4	16	6
Percent Elk Bagged	3	14	42	22	7	14	44	6	5	13	35	15
Percent Trip Success	2	5	11	5	2	1	5	1	1	3	8	2
Entire Season												
No. of Hunters	448	420	257	351	446	316	327	371	894	736	584	722
No. Elk Bagged	38	22	19	23	28	8	18	16	66	30	37	39
Percent Trip Success	8	5	7	7	6	3	6	4	7	4	6	5

[1]Hunting season one week shorter than in 1970 and 1971.
[2]Includes first 4 weekends in 1970-1971, first 3 weeks in 1972-1973.
[3]Includes last 3 weekends for all years.



[1]Includes 4 weekends in 1970 and 1971, and 2 weekends in 1972 and 3 weekends in 1973.
[2]Includes 3 weekends all years.

Figure 3. Comparisons of elk bagged, elk observed, hunters, and hours walked for the Upper Unit (restricted area) between first and second half of hunting season and between years.



[1]Includea 4 weekends in 1970 and 1971, and 2 weekends in 1972 and 3 weekends in 1973.
[2]Includes 3 weekenda all years.

Figure 4. Comparisona of elk bagged, elk observed, hunters, and hours walked for the Lower Unit (unreatricted area) between firat and second half of hunting season and between years.

Table 8. Sex and age of 434 elk checked during the 1970, 1971, 1972, and 1973 hunting seasons.

	Calf	1½ Male	1½ Female	2½+ Male	2½+ Female	Unk. Adult Male	Unk. Adult Female	Unk.	Total
1970									
Weekends	5	39	15	8	22	3	12	1	105
Camp Check	3	21	4	2	7	0	1	0	38
TOTAL	8	60	19	10	29	3	13	1	143
1971									
Weekends	9	32	9	6	14	1	5	0	76
Camp Check	0	11	0	1	5	1	3	0	21
TOTAL	9	43	9	7	19	2	8	0	97
1972									
Weekends	12	24	6	5	22	0	0	0	69
Camp Check	3	9	1	2	7	0	0	6	28
TOTAL	15	33	7	7	29	0	0	6	97
1973									
Weekends	4	49	2	11	11	0	4	0	81
Camp Check	0	10	0	0	3	1	1	1	16
TOTAL	4	59	2	11	14	1	5	1	97
All years combined									
Weekends	30	144	32	30	69	4	21	1	331
Camp Check	6	51	5	5	22	2	5	7	103
TOTAL	36	195	37	35	91	6	26	8	434

stations and a camp check that was performed the second day of the hunting season in 1970, 1971, and 1972 and the third day of the hunting season in 1973. Of the total known elk harvest in 1973, 4 percent were calves, 73 percent antlered bulls, and 22 percent adult cows. This compares with 15, 41, and 37 percent, respectively, for 1972; with 9, 54, and 37 percent for 1971; and with 6, 51, and 43 percent in 1970. Of known age adults checked in 1973, 84 percent of the bulls and 13 percent of the cows were yearlings. This compares with 83 and 19 percent, 86 and 32 percent, and 86 and 40 percent, respectively, for 1972, 1971 and 1970.

Hunter Behavior, Use of Area, and Elk Observations

The closure restrictions appeared to increase hunter effort (hours walked per hunter per day) during the entire hunting season in both the upper and lower units of the study area. Hunter effort in the study area during 1973 was similar to that in 1972 and was considerably greater than in 1971 and 1970 (Table 9) (Fig. 5). In the upper unit a pronounced increase occurred in hunter effort during the first half of the season in 1972 and 1973 compared to 1970 and 1971. An increase in hunter effort also occurred during the second half of the season in 1972 and 1973. This increase during 1972 and 1973 in the upper unit can largely be attributed to the closure; the reason for the large increase in hunter effort in the lower unit throughout the season is difficult to understand, since this area was unrestricted to vehicle traffic. The closure restrictions could have been an indirect factor by influencing a change in hunter attitudes and hunting methods throughout the entire upper Ruby River drainage.

Elk observed per unit of hunter effort (elk seen per hunter-hour-walked and elk observed per hunter per day) showed a significant increase during the second half of the season in the upper unit during the 2 years of the closure in 1972 and 1973; this occurred even though more hours were walked per hunter and more hunters hunted the upper unit during this portion of the season than in 1970 and 1971. Conversely, elk observed per unit of hunter effort decreased during the second half of the season in the lower unit (unrestricted) from 1972 to 1973 and elk seen per hunter per day was lowest in 1973, although elk seen per hunter per day in this unit was unexplainably highest in 1972.

During the first half of the season more elk were seen per unit of hunter effort in 1970 and 1971 for both the upper and lower units of the study area than in 1972 and 1973. In the study area, especially the upper unit, most elk during the opening week of the season are seen in the open moving from one stand of timber to another. It is likely that because of the greater disturbance caused by the unrestricted motorized traffic during 1970 and 1971, terrain and cover patterns, more elk were moved around and subsequently seen than after restrictions were imposed. Figures 3, 4, and 5 and Table 9 summarize the apparent effect of the closure restrictions, on hunter effort and elk harvest and observations; this effect was especially pronounced during the second half of the season in the upper unit. Two percent of the study area hunters checked in 1973 were road hunters (they did no walking) and accounted for less than 1 percent of all elk observations. These same figures for 1972 were 11 and 6 percent; 1971 - 7 and 6 percent; and 1970 - 4 and 11 percent, respectively.

Radio-Marked Elk

Prior to the road closure in 1972 and 1973, existing evidence suggested that most elk left the upper unit of the study area early in the hunting season. Data gathered during the 1970 hunting season substantiated that indication. To obtain more precise information on elk movements

le 9. Number of hunters, hours walked, and elk observed.

UPPER UNIT

Time Period	Number of Hunters				Hours Walked				Hours Walked/ Hunter/Day				Elk Observed				Elk Observed/ Hunter/Day				Elk Observed/ Hours Walked			
	1970	1971	1972[1]	1973[1]	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973	1970	1971	1972	1973
First Half[2] of Season	383	356	149	254	943	963	748	1,370	2.5	2.7	5.0	5.4	1,041	850	256	902	2.7	2.4	1.7	3.6	1.1	.88	.34	.66
Last Half[3] of Season	65	64	76	97	226	185	310	401	3.5	2.9	4.1	4.1	74	57	138	394	1.1	.9	1.8	4.1	.33	.30	.44	.98
Entire Season	448	420	225	351	1,169	1,148	1,058	1,771	2.6	2.7	4.7	5.0	1,115	907	394	1,296	2.5	2.2	1.8	3.7	.95	.79	.36	.73

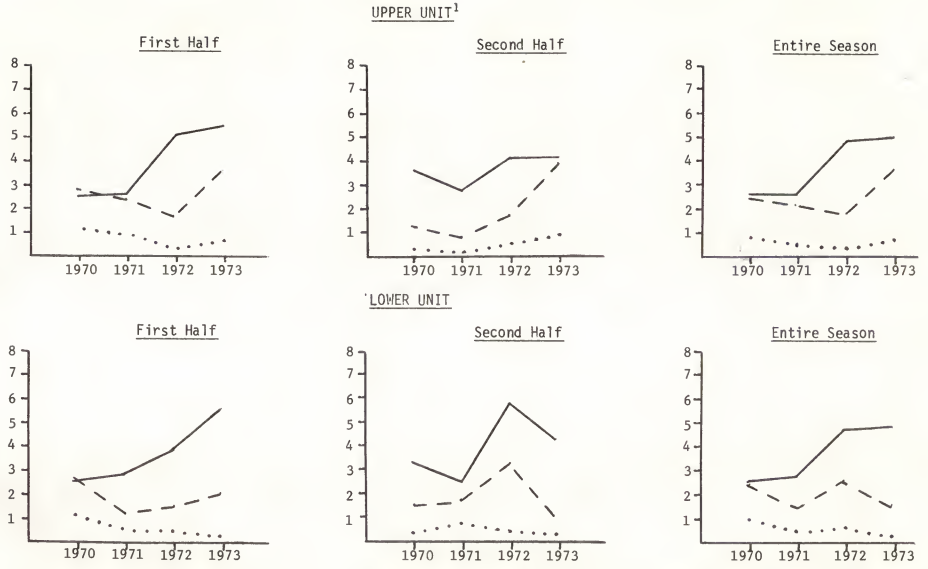
LOWER UNIT

First Half[2] of Season	332	227	147	218	786	666	569	1,195	2.4	2.9	3.9	5.5	881	286	234	439	2.7	1.3	1.6	2.0	1.1	.40	.40	.37
Last Half[3] of Season	114	89	114	153	387	223	666	636	3.4	2.5	5.8	4.2	178	160	380	146	1.6	1.8	3.3	1.0	.46	.72	.57	.23
Entire Season	446	316	261	371	1,173	889	1,235	1,831	2.6	2.8	4.7	4.9	1,059	446	614	585	2.4	1.4	2.4	1.6	.90	.50	.50	.32

BOTH UNITS

First Half[2] of Season	715	583	296	472	1,729	1,629	1,317	2,565	2.4	2.8	4.4	5.4	1,922	1,136	490	1,341	2.7	1.9	1.7	2.8	1.1	.70	.37	.50
Last Half[3] of Season	179	153	190	250	613	408	976	1,037	3.4	2.7	5.1	4.1	252	217	518	540	1.4	1.4	2.7	2.2	.41	.53	.53	.52
Entire Season	894	736	486	722	2,342	2,037	2,293	3,612	2.6	2.8	4.7	5.0	2,174	1,353	1,008	1,881	2.4	1.8	2.1	2.6	.93	.66	.44	.52

[1]Hunting season 1 week shorter than in 1970 and 1971.
[2]Includes first 4 weekends in 1970-1971; first 2 weekends in 1972 (data from 2nd week incomplete and not included), and first 3 weekends in 1973.
[3]Includes last 3 weekends for all years.



[1]Restricted to foot and horse travel in 1972 and 1973.

Figure 5. Comparison of hours walked per hunter per day, elk observed per hunter per day, and elk observed per hour walked between upper and lower units of the study area and between years of the study.

early in the hunting season, four elk were marked with radio transmitters in late September and/or early October each year in 1971, 1972, and 1973 by means of helicopter and capture gun. All elk were adult cows and were immobilized in or adjacent to the upper unit of the study area.

During 1971, all four elk were relocated out of the study area shortly after the hunting season opened, October 17. Two elk were killed only 4 days after the season opened a few miles west while a third was observed the fifth day of the season in the head of the East Fork of Blacktail Creek, several miles west; this elk was killed about mid-November. The fourth elk was not located during an October 22 aerial flight but was located October 29, 1 mile east of the study area. This elk wintered in the vicinity of the Wall Creek Game Range several miles east of the study area.

Two of the four elk marked in 1972, were still in the study area just prior to the hunting season. Immediately after the onset of hunting one of these elk moved out of the study area and never returned while the other one remained in the study area until it was killed on or about November 9, 1972. The other 3 animals survived the hunting season and were last located on winter ranges. An aerial flight on December 5, 1972, revealed elk tracks still moderately scattered throughout the upper portion of the study area.

Just prior to the hunting season in 1973, 2 of the 4 animals collared, were still in the upper unit and remained there for at least the first 2-3 days of the hunting season. One of these elk was killed on October 25, the 5th day of the season, about 4 miles west of the study area and the other elk was last located on October 22 in the upper unit of the study area. Travel to and within the study area and terrain and cover patterns necessitate aerial surveys to monitor the radio-equipped elk. Adverse weather conditions throughout and beyond the hunting season in 1973 prevented aerial surveys of the area, precluding the relocation of radio-collared elk after October 23, 1973.

Relocations and movements of 4 radio-collared adult cow elk during the 1971 hunting season indicated a significant migration of elk away from the study area (in several directions) occurred shortly after the hunting season opened. During the 1972 season, observations of radio marked and other elk suggested a tendency for elk to remain in the upper unit of the study area throughout the season. Although the data for 1973 is very limited, it also suggests a tendency for elk to remain in the upper unit for at least the first 2-3 days of the hunting season. This tendency is probably in direct response to the road closure regulations and the less intense hunter activity.

Submitted By: Terry N. Lonner

JOB III-A.2

JUDITH ROAD CLOSURE STUDY

Progress Report for the Period Jan. 1, 1973 - Dec. 31, 1973

INTRODUCTION

The objective of this study is to determine the effect of road closure during the hunting season on elk distribution and harvest, and on hunter distribution, in a portion of the Little Belt Mountains of central Montana. The area has been extensively logged and roaded, and access is very good.

Hunter interviews at weekend checking stations provided data on elk distribution and harvest, and on hunter distribution, during each hunting season from 1970 through 1973. Access was unrestricted in 1970 and 1971. During the 1972 and 1973 seasons, access remained unrestricted in the east and west portions but was limited in the central half of the study area (fig. 1) by permanent closure of approximately 70 miles of a 167-mile network of roads, and by prohibiting all off-road vehicular travel.

FINDINGS

Hunting Pressure

Hunting pressure evidently was not affected by the road closure (table 1). Apparently the restrictions on vehicular use, well publicized in advance of the season, did not deter any appreciable numbers of hunters from using the area in 1972. The sizeable increase in numbers of hunters in 1973 is believed not to have been a reaction to road closure; rather, the increase is believed to reflect a reaction to the then recently experienced condition of steeply rising retail prices of meat, closing of meat packing plants, and threats of severe meat shortages engendered by stockmen withholding animals from market.

The pattern of hunting pressure as the season progressed was essentially the same in all 4 years (fig. 2). About one-third of the season's total pressure occurred on opening weekend, and one-half in the first 8 days. Hunting pressure beyond the second weekend remained fairly steady, with a slight upturn on the last weekend.

Elk Sightings

The patterns of elk sightings and of elk kill with seasonal progression also were essentially the same for all 4 years (fig. 2). Furthermore, these patterns closely paralleled that for hunting pressure, indicating that the numbers of elk seen and the numbers killed on any given weekend were roughly proportional to the number of hunters afield. This close paralleling of patterns of hunter pressure and of elk sightings and kills further indicates that elk did not emigrate in response to hunter pressure during any of the four seasons, even during those years of unrestricted access.

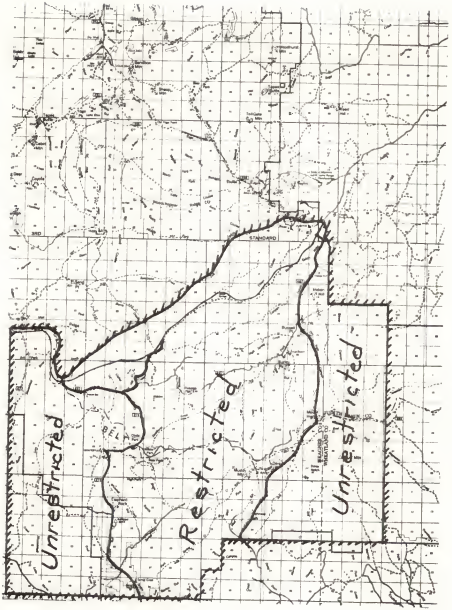


Figure 1. Zones of restricted and unrestricted access in the South Fork of the Judith River Study Area.

Table 1.--Hunting pressure, elk sightings, and elk harvest during two seasons of unrestricted access and two seasons of restricted access.

	Unrestricted Access		Restricted Access	
	1970	1971	1972	1973
Hunters	2131	2417	2226	2800
Elk Seen	993	1376	1736	1713
Elk Seen/Hunter	0.47	0.57	0.78	0.61
Elk Killed	27	53	46	68
% Hunter Success	1.27	2.19	2.07	2.43

Table 2.--Percentages of road hunters and of field hunters under conditions of unrestricted and restricted access, and success of hunters in seeing and killing elk.

	ROAD HUNTERS				FIELD HUNTERS			
	Access Unrestricted		Access Restricted		Access Unrestricted		Access Restricted	
	1970	1971	1972	1973	1970	1971	1972	1973
% of all Hunters	16.7	16.7	9.9	6.8	83.3	83.3	90.1	93.2
% of Elk Seen	5.5	4.2	0.4	0.1	94.5	95.8	99.6	99.9
% of Elk Kill	0.0	3.8	0.0	0.0	100.0	96.2	100.0	100.0
Elk Seen/Hunter	0.15	0.15	0.03	0.01	0.53	0.65	0.86	0.66

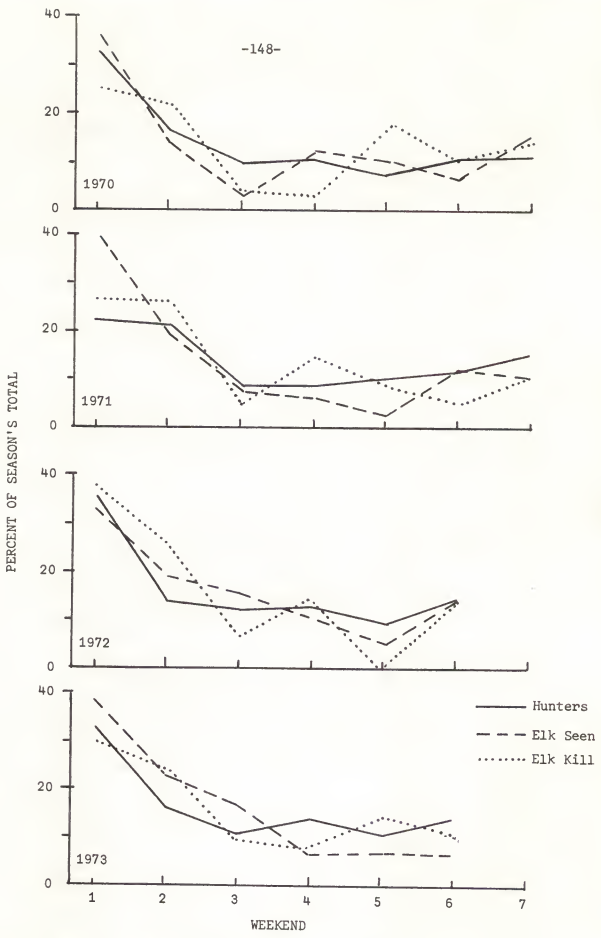


Figure 2. Seasonal progression of hunting pressure, elk sightings, and elk harvest in four hunting seasons in the South Fork of the Judith River area.

Year-to-year variations in elk harvest in seasons with like access tend to mask possible differences in harvest attributable to restricting access. However, average values for the restricted versus unrestricted periods show a 43% increase in elk kill following road closure. This corresponds closely to the 46% increase in total numbers of elk sighted, and to the 33% increase in number of elk seen per hunter. Hunter numbers for the same period increased only 11%.

The increase in elk sightings probably was due to a greater percentage of hunters afoot, and a lesser degree of harassment by vehicles, under restricted access than under unrestricted access.

Road Hunters vs. Field Hunters

In the two seasons of unrestricted access, 1 of every 6 hunters was a road hunter (defined here as one who spent less than 15 minutes afoot in search of elk). After restricting access, only 1 of approximately every 12 hunters was a road hunter. The limiting of access either converted some road hunters to field hunters, or it attracted proportionately more field hunters than road hunters. Field hunters were more successful than road hunters in seeing and harvesting elk (table 2). Field hunters made from 95% to over 99% of all the elk sightings, and took all but one of the reported elk kills in the 4 years of study.

Hunter and Elk Distribution

Although elk did not leave the study area during the hunting seasons, they did move about considerably within the area. The study area was divided into 11 units (largely on the basis of road locations), and the number of elk seen in each unit on a given weekend was expressed as a percentage of all elk seen in the study area that weekend. Hunter distribution was similarly computed.

Plottings of both elk distribution and of hunter distribution for each weekend of each season showed similar results: that elk distribution is constantly shifting between units, and that this distribution apparently is, to a large degree, independent of hunter distribution. No discernible differences were noted in distributions either of elk or of hunters as a result of the restrictions on access.

Submitted by:

Joseph V. Basile

JOB III-B

ELK USE OF DISTURBED AREAS

Progress Report for the period Jan. 1 - Dec. 31, 1973

INTRODUCTION

Seral vegetation in the openings created by clearcutting should, logically, provide an increased forage resource for big game. However, forage alone does not necessarily provide an adequate habitat. Land managers are concerned that size, shape, location, and age of openings may be at least as important as forage availability in determining use by game animals. Job III-B of the Montana Cooperative Study has as a major objective the description of animal use of existing clearcut openings.

LITERATURE

Although several papers have been published describing elk and deer pellet distributions in logged areas, the information has been either of a preliminary nature or confined to areas and habitat types far removed from Montana conditions. Reynolds (1964), for example, found greatest densities of pellets in New Mexico pinyon-juniper on northeast aspects with high tree and shrub densities. He recommended leaving this cover except where trees were overtopping shrubs. In ponderosa pine of Arizona, however, he recommended thinning or cutting on north slopes because a greater response in understory vegetation could be expected (Reynolds, 1962a). Deer use of logged ponderosa pine sites declined for two years and then rose to levels higher than prelogging for 8 to 15 years.

Reynolds (1966a and 1962b) has also reported deer and elk pellet distributions in forest openings. He concluded that openings smaller than 20 acres in spruce-fir and smaller than 45 acres in ponderosa pine receive the most use.

A more recent study, completed by Gary Halvorson (mimeo 1972) reports deer and elk pellet distributions on eight clearcuts on the Lolo National Forest. This work, while admittedly limited, suggested a number of conclusions which should be further explored.

1. Deer use was greatest in the forest, but elk use was greater in clearcuts than in uncut forest.

2. Peak pellet densities for both deer and elk in clearcuts were recorded at 7 to 8 chains from the forest edge.

3. Size of opening appears to be less important than the ratio of edge to area in determining animal use.

4. Vegetation height within the clearcut also seems to be important in determining animal use.

Literature Cited

Halvorson, G. L. 1972.
Deer and elk use in clearcuts and adjoining uncut forest, Lolo National Forest, Montana. Lolo N.F., mimeo 7 pp., unnumbered.

Reynolds, H. G. 1962a.
Effect of logging on understory vegetation and deer use in a ponderosa pine forest in Arizona. USDA Forest Serv., Rocky Mtn. Forest and Range Exp. Sta., Res. Note No. 80. 7 pp.

Reynolds, Hudson G. 1962b.
Use of natural openings in a ponderosa pine forest of Arizona by deer, elk, and cattle. USDA Forest Serv., Rocky Mtn. Forest and Range Exp. Sta. Res. Note 78. 4 pp.

Reynolds, Hudson G. 1964.
Elk and deer habitat use of a pinyon-juniper woodland in southern New Mexico. Trans. N. Amer. Wildl. Nat. Res. Conf. 29: 438-444.

Reynolds, H. F. 1966a.
Use of openings in spruce-fir forests of Arizona by elk, deer, and cattle. USDA Forest Serv., Rocky Mtn. Forest and Range Exp. Sta. Res. Note RM-66. 4 pp.

OBJECTIVES

The objectives of this study are to describe, in detail, the distribution of elk and deer pellet groups in timber harvest openings and to relate these distribution patterns to size, shape, and location of openings as well as the environmental factors associated with the openings.

METHODS

Several different sampling schemes were suggested and discussed by the Research Committee during the preparation of this plan. However, the logistical problems of locating plots not distributed along line transects appeared almost insurmountable. As a result, the method finally selected utilizes a baseline through the longest axis of the opening with one to five transects equally spaced at right angles crossing the baseline. Appendix 1 is a copy of the directions and data sheets for field sampling. Each of the entries is coded so that ADP cards can be punched directly from the field sheets.

Sample Openings

Selection of areas to be sampled was basically subjective. On the basis of recommendations by local Forest Officers and Game Department personnel, general areas of past clearcutting in known elk range were examined on aerial photographs. From the photographs, openings representing a variety of sizes, shapes, locations, and ages was selected. The only limitation on this selection process was that the opening sampled had to include all cutting units so that the sample unit was entirely surrounded by uncut timber.

During the summer of 1972 several openings in the Sapphire Mountains were sampled to provide a test of the sampling method, and in 1973 a two-man crew was assigned this job for the field season. In addition to the cuttings in the Sapphires, openings were sampled in the East Fork of the Bitterroot, in the Granite Pass area on Lolo Creek, in the Gilbert Creek and Schwartz Creek area east of Missoula, on the Ninemile Ranger District north of the Clark Fork River, on the Flathead National Forest north of Hungry Horse Reservoir, and in the Condon-Holland Lake area. In total, 50 clearcuts were sampled, but one cutting was deleted from the analysis because it had no elk or deer pellets in the sample. A listing of the 49 sampled openings showing location, size, and average number of pellet groups per plot is presented in Table 1.

ANALYSIS

The initial analysis for these data was to have taken the form of a distributional curve showing average number of pellet groups per plot at various distances from the edges of openings. Two examples of such summaries, utilizing data from all 49 samples, are presented in Figures 1 and 2. It should be noted in examining these two figures that the size of opening has not been considered. Thus, sample sizes become smaller as distance from the edge increases. Moreover, as this distance increases, the figure becomes less and less representative of the range of clearcut sizes because only the largest openings supply data for distances greater than 400 feet.

Figure 1 describes the distribution of elk pellets on all plots in relation to distance from the edge of the opening and relationships of the plot to any kind of road construction. As a general rule, roads within the cutting units were jammer roads on which vehicular traffic was no longer possible while roads outside the cuttings were generally accessible to vehicles. The description, then, indicates that the effects of roads on elk pellet distribution are essentially negative irrespective of whether the roads have been closed to traffic. Within the openings, plots on or very near roads averaged about 0.3 fewer pellet groups than plots independent of roads. In uncut timber surrounding the openings, there were about 0.8 more pellet groups per plot where roads were not an influence.

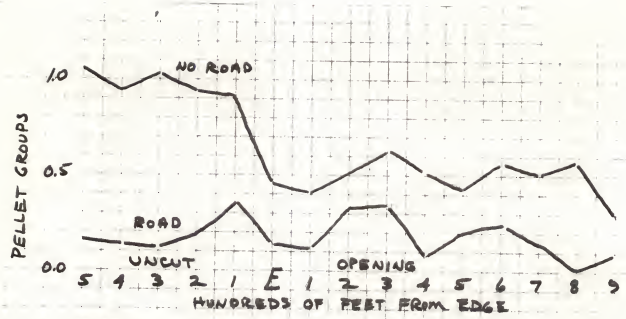


FIGURE 1.- AVERAGE NUMBER OF ELK PELLET GROUPS PER PLOT AS INFLUENCED BY ROADS, ALL SAMPLES COMBINED

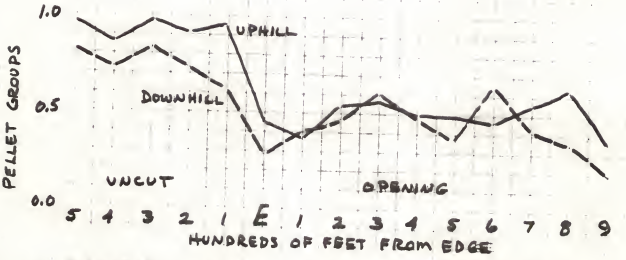


FIGURE 2.- AVERAGE NUMBER OF ELK PELLET GROUPS PER PLOT AS INFLUENCED BY TOPOGRAPHY, ALL SAMPLES COMBINED

Figure 2 describes the distribution of pellet groups across openings in relation to distance from the edge and whether the plot was uphill or downhill from the center of the opening. There is a trend in these data which suggests some slight preference for the uncut timber on the uphill edge of openings, but the distribution of pellets inside the opening appears to be more or less constant at any distance from the edge.

Further analysis of this type were attempted, but the subdivision of samples into categories based on size or shape gave very inconsistent results. It was found, for example, that openings under 20 acres and between 40-100 acres averaged over 0.5 pellet groups per plot while 20-40 acre openings averaged only 0.3. Moreover, the under 20 acres and 40-100 acre openings were heavily utilized in the center while the 20-40 acre openings were almost unused. Several other anomalies, such as high pellet concentrations in the uncut forest around 40-100 acre openings were noted.

As a result of these analytic problems, it was decided that the data will require a more sophisticated analysis than originally planned. The initial step in this planned analysis was a multiple-linear regression screen using the mean number of elk pellets per plot within openings as a dependent variable and the following variables as independent predictors:

1 - mean number of deer pellets per plot in the opening
2 - mean height of vegetation in the opening
3 - mean depth of slash in the opening
4 - mean number of elk pellets per plot in the uncut
5 - mean number of deer pellets per plot in the uncut
6 - mean cover quality index for the uncut
7 - mean depth of dead and down in the uncut
8 - perimeter of the opening
9 - acres of the opening
10 - perimeter 2/acres (a descriptor of shape)

The computer program for this analysis follows a sequence in which all possible regression equations using 1, 2, 3, 4, 5, etc., independent variables are calculated. At each step, the smallest relative mean squared residual is considered representative of the best set of independent variables (RMSQR = MSQR/VAR. Y). The relative mean squared residual, however, does not necessarily decrease as each new variable is added, and at some point the addition of an independent variable will fail to improve the prediction, i.e., the residual increases. The entire sequence for elk pellet predictions is presented in Table 2. In this analysis, only 8 steps were involved because the three variables describing opening size were not used simultaneously.

Table 2.--Independent variables added and resultant relative mean squared residual, elk pellet groups as the dependent variable.

Independent variables	Variables used at each step							
	1	2	3	4	5	6	7	8
Deer pellets inside	X	X	X	X	X	X	X	X
Vegetation inside								X
Slash inside		X			X	X	X	X
Elk pellets in uncut			X	X	X	X	X	X
Deer pellets in uncut			X	X	X	X	X	X
Cover quality uncut				X	X	X	X	X
Dead and down uncut							X	X
Perimeter of opening								
Acreage						X	X	X
Perimeter 2/acreage								
Relative mean squared	.399	.371	.358	.321	.292	.287	.291	.297

Examination of Table 2 reveals that the best prediction occurred with six independent variables. At this point, the mean square residual was .287. R squared for this set of six variables = .749 and the regression equation was:

$$Y = -.184 + .893 \text{ Var } 1 - .296 \text{ Var } 5 + .219 \text{ Var } 4 + .361 \text{ Var } 6 - .254 \text{ Var } 3 - .00112 \text{ Var } 6$$

This equation is not particularly helpful in answering the objectives of this study, but it does help to explain the inconsistencies of the analyses already described. The three most important independent variables for predicting the number of elk pellets in a clearcut opening are the number of deer pellets in the opening and the numbers of deer and elk pellets in the uncut area around the opening.

The obvious conclusion is that the expectation of elk pellets inside a clearcut opening is greater if the opening occurs in an area which supports big game. More specifically, however, this result demonstrates that stratification of samples for animal population levels is a mandatory prerequisite to detection of any patterns of animal preference. After the effects of animal population levels have been accounted for, the regression in Table 2 suggests that dense cover around the opening, low slash depths, and smaller openings are favorable in determining elk use of clearcuts.

However, there are a number of reasons to believe that this simple linear analysis may not describe the total relationships. The regression coefficient for deer pellets outside the opening, for example, is negative, and the multiple regression equation for deer pellets on clearcuts includes a negative coefficient for the uncut cover surrounding the openings. Thus, we can conclude that deer prefer less dense cover while elk select the situations with heavier cover--unless there is some level of interspecific intolerance, in which case cover quality may not be involved at all.

Whatever the case, there seems to be a substantial number of factors other than the clearcut itself which combine to determine the degree of use by game animals. Two further analyses are in process, but neither is complete at this writing. One test is a screening process in which individual plots are sorted independent of the clearcut in which they were located while the other is an algebraic transformation and curve-fitting process on means from the openings.

CONCLUSIONS

Analyses are incomplete at this time, but the initial indications of pellet groups distribution around clearcuts suggest the following very tentative conclusions:

1. That elk may avoid roads where there is no vehicular traffic.

2. That uphill uncut edges are slightly preferred over downhill edges (if this variable can be isolated it should lead to a recommendation concerning design of clearcut openings).

3. That cover quality adjacent to cutting units is important to elk.

4. That good slash cleanup is favorable to elk use of openings.

5. That smaller openings are preferable (unfortunately the analysis at this point does not make it possible to define "small" or suggest the most favorable size).

APPENDIX I

SURVEY OF BIG GAME USE OF TIMBER HARVEST OPENINGS (Page 1)

LOCATION AND SIZE OF TIMBER HARVEST OPENING [1-4] ____

Forest _____ Observer _____ Date _____ [5-6] ____

Opening name _____ Location ____ ____ ____
sect. twp. rng.

State _____ [7] ____

County _____ [8-9] ____

Perimeter of opening _____ feet[1/] [10-14] ____

Acres in opening _____ [15-18] ____

Is there another cutting within 1/2 mile? yes no (circle one) [19] ____

Number of cutting units in opening _____

Were all the cutting units sampled? yes no (circle one)

[1/] In those situations where a total opening could not be defined, enter data for each cutting unit followed by the letters "CU."

SURVEY OF BIG GAME USE OF TIMBER HARVEST OPENINGS (Page 2)

DESCRIPTION OF CUTTING UNIT

Opening name _____ Cutting unit ID _____ [20] ___

COVER ADJACENT TO CUTTING UNIT

Length of baseline is _____ feet [21-24] ___

Enter appropriate codes in boxes at right:

1 uncut timber
2 natural opening or pasture
3 another cutting unit
4 combination of 1 & 2
5 combination of 1 & 3
6 combination of 2 & 3
7 uncut with road
8 other (describe)

Line	Code for Projections X	Code for Projections Y	If 3 or 5 Distance to X uncut, feet	If 3 or 5 Distance to Y
Baseline				
Transect 1				
Transect 2				
Transect 3				
Transect 4				
Transect 5				

HISTORY OF CUTTING UNIT

Year of timber harvest _____ [61-62] ___

Year of last treatment _____ (slash disposal, planting, etc.) [63-64] ___

Harvesting method (check one)
___ clearcut, including group selection
___ partial cut (seed tree, etc.)
___ overstory removal
___ individual tree selection
___ other (specify)

Slash treatment (check one) [66] ___
___ broadcast burned
___ piled and burned
___ piled only
___ lop and scatter
___ other (specify)

Planted yes no (circle one) [67] ___

If so, average height in feet _____ [68-69] ___

DESCRIPTION OF CUTTING UNIT

Habitat type or types _____ _____ [70-71] ___

Slope % _____ [72-73] ___

Aspect _____ [74] ___

Elevation _____ [75-76] ___

If this cutting unit on big game winter range?
yes no (circle one) [77] ___

Is it possible to drive a jeep, on a road (check one) [78] ___
___ into or through the unit
___ to the edge only
___ within 1/4 mile
___ none of these

The nearest access to water is (check one) [79] ___
___ within the unit
___ within 1/4 mile of the unit
___ over 1/4 mile from the unit

[80] 1

PELLET COUNT DATA

[1-4] ____
Cutting Unit ID ____ [5] ____
[6-7] ____

Transect No. ____

From edge across cutting unit																From edge into uncut				
Plot No.	Elk	Deer	Veg.	Slash	Plot No.	Elk	Deer	Veg.	Slash	Plot No.	Elk	Deer	Veg.	Slash	Plot No.	Elk	Deer	Cover	Slash
Edge			X		10					20					X1				
1					11					21					X2				
2					12					22					X3				
3					13					23					X4				
4					14					24					X5				
5					15					25					Y1				
6					16					26					Y2				
7					17					27					Y3				
8					18					28					Y4				
9					19					29					Y5				
		2					3					4							7

Transect No. ____ [6-7] ____

Edge			X		10					20					X1				
1					11					21					X2				
2					12					22					X3				
3					13					23					X4				
4					14					24					X5				
5					15					25					Y1				
6					16					26					Y2				
7					17					27					Y3				
8					18					28					Y4				
9					19					29					Y5				
		2					3					4							7

Transect No. ____ [6-7] ____

Edge			X		10					20					X1				
1					11					21					X2				
2					12					22					X3				
3					13					23					X4				
4					14					24					X5				
5					15					25					Y1				
6					16					26					Y2				
7					17					27					Y3				
8					18					28					Y4				
9					19					29					Y5				
		2					3					4							7

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APPENDIX

APPENDIX I

During the report period two M.S. theses were completed for jobs associated with the elk-logging study; following are their abstracts:

Stehn, Thomas V. 1973. Daily movements and activities of cow elk in the Sapphire Mountains of Western Montana during summer and fall. M.S. thesis, Univ. of Montana, Missoula. 66 pp.

ABSTRACT

During summer and fall, 1972, radioed cow elk were located 799 times, mostly at 3-hour intervals, including 62 diel periods. Using a pulse-height, detector-Rustrak recorder system, 45,817 minutes of elk activities were classified as either active or bedded. Intrarange movements of one cow elk were documented throughout the study period. Reliability of both ground triangulation methods and use of the activity meter were tested, and associated problems are discussed. In general, rugged topography greatly limits the accuracy of ground triangulating methods.

Repetitive, daily movement patterns were uncommon; the same areas were rarely used on consecutive days. Movement peaks occurred during the 3 hours following sunrise and sunset. Total distance moved during diel periods averaged 2.4 miles. Net displacement between 24-hour locations averaged 0.8 miles. Elk moved an average of 0.9 miles before settling down after human disturbance.

The daily activity rhythm was highly variable from day-to-day. Cow elk were active 68.2 percent of the time during summer, and 58.0 percent during fall. These differences held for both diurnal and nocturnal periods. Elk spent approximately equal percentages of time active during day and night. Major active peaks occurred at sunrise and sunset. Times of the greatest amount of bedding were less pronounced, and occurred at midday and 1.5 hours before sunrise. There were 12 alternating bedding and feeding periods per 24 hours. The longest feeding bouts were at sunrise and sunset, averaging 184 and 217 minutes in length, respectively. During both day and night, feeding and bedding bouts were similar in length and averaged between 94 and 103 minutes. Long, daytime or nocturnal bedding periods were not observed.

Denton, J. 1973. A radio telemetry system for elk: its use and efficiency. M.S. thesis, Univ. of Montana, Missoula. 77 pp.

ABSTRACT

A double whip-dipole antenna receiver system utilized in this study is practical, and adapts well to tracking elk in mountainous terrain in

Western Montana. There are several advantages involved. The receiver system is easy to use after a relatively short training period. Locations can be plotted accurately on aerial photographs, depending on the ability of the observer. Many bits of data are possible for each location; behavior during visual observation, meteorlogical conditions, habitat parameters, time and topography for both visual and approximate locations are examples. This system allowed an observer to locate seven elk and nine elk, in 1971 and 1972, respectively, into often times remote and inaccessible areas spread over 200 square miles of mountainous terrain. It took two hours flying to accomplish this. This would be difficult for one person on the ground, because individual animals may be separated by as much as fifteen airline miles at any one time. Approximations of unseen radioed animals are accurate enough, on occasion, to facilitate finding the exact site of animal activity by ground search. Equipment is dependable as long as an observer is knowledgeable in its use and care. Minor problems of dirty connections, power loss, or loose components can occur and be corrected promptly. Reuse of most recovered transmitters is an advantage; however, recovering transmitters from radioed animals or from where they may have fallen off after malfunctioning is difficult. Animals do not appear to be harmed by radio collars nor harassed from aircraft.

No system is without its limitations. Loss of transmitters occurs. Transmitter malfunction is a problem difficult to solve without recovering transmitters as soon as they malfunction. An observer cannot observe elk any time of the day or night nor in all weather conditions. A number of locations are necessary for training pilots and observers to familiarize them with flight patterns required and use of equipment. Stormy, windy, cloudy, or excessively hot weather does not allow aircraft use in the desired manner or danger to aircraft and human life becomes a factor. Ratios of visual and approximate observations depend upon habitat use by elk under varying environmental conditions. The decision to use aerial telemetry should be made, based on the species to be studied and the type(s) of observations required to meet the objectives of the study.

The telemetry system, with an eight element Yagi antenna, is reasonably accurate for ground work on flat to rolling terrain, but error is two to three times greater in mountainous terrain. Multiple fixes and realization that greater error exists allow approximate locations only. The ground system does not allow frequent visual observation, nor can it locate several animals over 200 square miles of mountainous terrain. Determination of activity pattern changes and gross movements of animals is feasible from the ground; however, elk movements in inaccessible areas hinder triangulation work.

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IN REPLY REFER TO

United States Department of the Interior

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BUREAU OF LAND MANAGEMENT

STATE OFFICE
316 NORTH 26TH STREET
BILLINGS, MONTANA 59101

DEC 1 8 1974

Information Memorandum No. (Montana) MSO-74-129
Expires: 12/31/75

To: Director (360)
Director DSC (D-300)
All State Directors

From: State Director - Montana

Subject: Cooperative Elk-Logging Study;
Progress Report and Management Recommendations

I have enclosed for your information a copy of the recent annual progress report of the Elk-Logging Study. This study is a cooperative effort of the Montana Fish and Game Department, Forest Service - Region 1, Intermountain Forest and Range Experiment Station, University of Montana, and Montana BLM. Our Missoula District is carrying out the Chamberlain Creek segment of the study as part of their 1285 program.

One factor that makes the study unique is that an attempt is being made to formulate management recommendations during the course of the study as soon as research findings justify such recommendations. After four years of study, five recommendations were agreed upon - the "Elk Management Recommendations for the Consideration of Land Managers'" are found on pages xiii through xvi.

I can supply additional copies of the recommendations on your request.

Edrain Bradley

Enclosure - 1
Encl. 1 - Progress Report

cc:
Directors - (340), DSC (D-340) and (D-360)
DM's - Lewistown, Billings, Malta,
Dillon and Missoula

United States Department of the Interior

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Edwin Dudley

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